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RCRA FACILITY INVESTIGATION PROPOSAL CIBA-GEIGY FACILITY CRANSTON, RHODE ISLAND

VOLUME 3 OF 6

PROJECT QUALITY ASSURANCE PLAN

Submitted by:

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Date: SEPTEMBER 1989

(Responsible Professional)

(Project Quality Assurance Officer)



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SECTION 3 PROJECT DESCRIPTION

The United States Environmental Protection Agency (USEPA) has issued an Administrative Order on Consent (Order) to CIBA-GEIGY Corporation pursuant to the Resource Conservation and Recovery Act (RCRA). The Order (No. I-88-1088) requires that a RCRA Facility Investigation be conducted at the CIBA-GEIGY facility in Cranston, Rhode Island. The Order was signed by CIBA-GEIGY Corporation on 9 June 1989 and became effective on 16 June 1989.

The RCRA Facility Investigation (Facility Investigation) is one phase of the RCRA corrective action program. That program also consists of the RCRA Facility Assessment (Facility Assessment) which precedes the Facility Investigation, and the Corrective Measures Study (CMS) which follows the Facility Investigation.

The Facility Assessment is intended to identify and gather formation on known or potential releases, evaluate Solid Waste Management Units (SWMUs) and Areas of Concern, and make preliminary determinations regarding conditions of concern and the need for further action including interim measures. Those measures are designed to mitigate potential or actual releases that could endanger human health and/or the environment.

The Facility Investigation is conducted to characterize the impact of known or suspected releases that were determined to require further action based on the Facility Assessment. The Facility Investigation includes the Risk Evaluation. The Risk Evaluation is designed to identify the human populations and environmental systems that may be impacted by conditions of concern associated with the facility. The Media Protection standards are then established for each media of concern. The Media Protection Standards are based on the Risk Evaluation, promulgated standards and non-promulgated criteria.

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The Corrective Measures Study determines the potential engineering solutions to the facility problems as indicated by the Media Protection Standards. The solutions (corrective measures) are evaluated based on performance, reliability, ease of implementation, timeliness, protection of human health and the environment, and cost effectiveness.

The purpose of the Project Quality Assurance Plan is to describe the management system that will be used to ensure that data and information generated during the Facility Investigation are technically sound and valid.

Laboratory quality assurance is the responsibility of the contract laboratory. Laboratory personnel involved in analyses of samples for this project are expected to comply with the procedures detailed in Volume 6 - Analytical Services Quality Assurance Manual.

SECTION 4 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization is shown on Figure 4-1. The project organization identifies the hierarchy and responsibilities of individuals involved in the project. The roles of key individuals on CIBA-GEIGY's site investigation consulting team are described below. Resumes for those individuals are provided in Appendix A.

<u>Responsible Professional</u>. The Responsible Professional (RP) has the overall responsibility for the project. He monitors the project work and provides supervision and support to the Project Manager (defined below). Some specific responsibilities of the RP are:

- assure that contracting and risk mitigation requirements are met, that
 the work is conducted in accordance with the terms of the contract, and
 that contractual changes are formally approved by CIBA-GEIGY (the
 Client);
- 2) assure that the Project Manager and staff are technically and professionally qualified, have adequate relevant experience, and represent sufficient resources to meet project objectives;
- 3) review project work and deliverables at least at designated project milestones;
- 4) assure that appropriate peer reviews are conducted;
- 5) assure that appropriate independent project consultants are assigned to projects judged to have unusually high risks and large consequences if project objectives are not met;

- assure that project files are established and that staff orientations are conducted;
- 7) encourage technology transfer to staff;
- 8) assure that project deliverables are provided on time and within budget; and.
- 9) establish and maintain communications with CIBA-GEIGY's project manager and assure that the objectives of the project, as prescribed by the contract terms, are met to the Client's satisfaction.

<u>Project Manager</u>. The Project Manager (PM) reports to the RP and has primary responsibility for all aspects of the project including meeting the needs of the Client. Specifically, his responsibilities include the quality of the work product, schedule and budget control, asset management, and communications with CIBA-GEIGY staff and superiors. Some specific duties of the PM are:

- implement contracting and risk mitigation requirements and determine
 if the services rendered are consistent with the terms of the contract;
- 2) determine that all contractual terms, including changes in scope, schedule and budget are formally agreed to by authorized representatives of the Client, and that such agreements are documented in writing;
- determine, in consultation with the Responsible Professional, that qualified staff are assigned to the project and represent sufficient resources to meet project objectives;
- 4) prepare a work plan (if not contained in the proposal) that describes staff assignments and conduct orientation meeting(s) for the project staff;

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- 5) conduct the project so that deliverables are of professional quality and formally reviewed at predetermined times by qualified staff.

 Reviewers may include project consultants, the RP and the PM;
- expedite the work of Peer Reviewers (defined below) involved in the project by formally communicating peer review schedules and providing the information required for peer reviews in a timely fashion;
- 7) in consultation with the RP, identify and engage project consultants for projects judged to have an unusually high risk together with large consequences upon failure to meet project objectives;
- establish and maintain project files; maintain written documentation of all relevant contractual, financial and administrative transactions, work plan conformance, quality assurance conformance, deliverables submitted, and other relevant technical and managerial data. Close the files upon completion of the project or of major project phases;
- 9) monitor schedules and budgets; provide notification to the Client of requirement budget or schedule adjustments before overruns have occurred; and document justification for such changes;
- 10) maintain close communications with and be readily available to the Client's representative to periodically assure that the Client's objectives are being satisfactorily met within the terms of the contract;
- 11) review, in a timely manner, all invoices to verify charges and their conformance with contractual terms; communicate with the Client concerning inquiries about invoices and interact with Accounting to facilitate collections; and

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12) present deliverables and, subsequently, contact the Client's representative to verify his/her understanding and ascertain his/her assessment of the work.

Peer Reviewer. Peer Reviewers (PR) will conduct reviews on work relevant to their field of expertise. A PR has the responsibility to conduct timely project peer reviews. Peer reviews will be conducted to provide assurance that the quality of services is in accordance with the standards of the profession, and that the objectives of the services and the terms of the agreement between the Contractor and the Client are met. Peer reviews will be completed prior to submission of the results of work or technical recommendations to the Client. Upon completion of a peer review, the PR will discuss his comments with the author/originator and will attempt to resolve any significant issues concerning the quality of the work reviewed. The final step of the peer review process is the completion of a Peer Review Documentation form (Figure 4-2).

<u>Project Quality Assurance Officer</u>. The Project Quality Assurance Officer (QAO) for this project will assist the PM in implementing the quality assurance plan for the project. The QAO is responsible for conducting quality assurance performance audits (see Section 12).

<u>Health and Safety Officer</u>. The Project Health and Safety Officer will have the following responsibilities:

- 1) to interface with the PM in matters of health and safety;
- 2) to develop a Health and Safety Plan for the project and to submit it to a corporate level Health and Safety Officer for approval;
- 3) to monitor compliance with the approved Health and Safety Plan;
- 4) to assist the PM in seeing that proper health and safety equipment is available for the project; and

5) to approve personnel to work on this site with regard to medical examinations and health and safety training.

<u>Project Administrator</u>. The Project Administrator (PA) will assist the project manager and relieve the technical staff of time consuming non-technical tasks. The PA will have the following responsibilities:

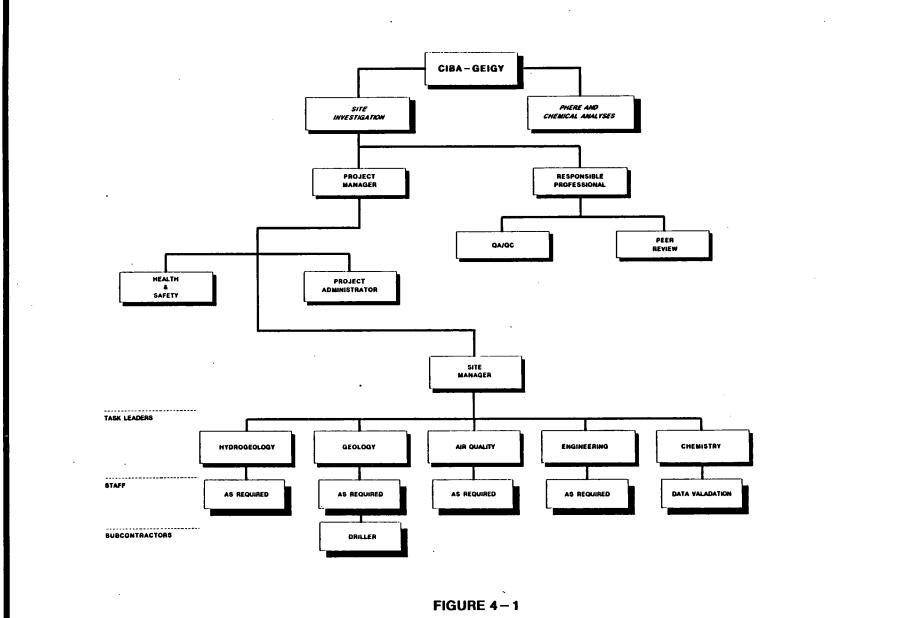
- maintain project management data base and programs to identify potential scheduling and cost problems requiring corrective procedures by the PM. Produce control documents and charts for progress reporting to CIBA-GEIGY and USEPA;
- 2) prepare staff assignment documents relating scope, budget and schedule for each individual responsible for the work items in order to meet overall project objectives;
- 3) track calendar deadlines to ensure that deliverables are in process to allow orderly review internally and by CIBA-GEIGY prior to mandated submissions to USEPA;
- 4) coordinate activities with other consultants retained by CIBA-GEIGY;
- 5) keep project document and correspondence files;
- 6) prepare monthly reports to CIBA-GEIGY describing progress during the past month and planned activities during the next two months;
- 7) edit and compile deliverables;
- 8) prepare monthly invoices to CIBA-GEIGY with supporting documentation.

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<u>Site Manager</u>. The Site Manager (SM) will be responsible for the coordination of site activities through communication with the various Technical Task Leaders (defined below).

<u>Technical Task Leaders</u>. The Technical Task Leaders are responsible for the coordination and evaluation of their area of professional expertise or technical task, as indicated on the organization chart. The implementation staff will be directly involved in the performance of technical tasks under the direction of the various task leaders. Technical tasks are identified on Figure 4-1; Technical Task Leaders are identified in Appendix A.

All staff members, whether with professional, technical, or administrative duties, have quality assurance responsibilities. Their responsibilities include: (1) being familiar with the requirements of the quality assurance plan; (2) being familiar with project-specific quality assurance program or procedures manual applicable to their assignment; (3) conducting specific project assignments according to the applicable requirements of the quality assurance program; (4) participating in assigned QA training and orientation programs; and (5) initiating a non-conformance and corrective procedures report.



PROJECT ORGANIZATION
CIBA – GEIGY FACILITY
CRANSTON, RHODE ISLAND

			PROJECT NUMBER AND NAME	
ER REVIEW DOCUMENTATION		CUMENTATION	SUBJECT	
		NOT REQUIRED FOR THE FOLI 1 Observations		Boring Logs
E:	xpert Testi	imony	Laboratory Tests	
Respons	ible Princi	pal/Associate		Date
SCOPE O	·	Letter	Following section of the	
PEER	_	Complete Report	Geotechnical	Environmental
REVIEW			Earth Science	
	_		Waste Management	pages to
PEER	PEER		REVIEWER	R'S CHECKLIST
REVIEWEI STATEMEI	=		SATISFACTORY APP	NOT PLICABLE NUMBER (over)
	formation 1	to required scope and		
		nd laboratory data.		
		ocuments and		
	-	e in files. Nechnical approaches	·	
	solutions.		<u> </u>	
	•	olculations, drawings,		
•	ons and tab enization	oles. clarity and complete-		
-	of report		<u> </u>	
		and completeness of		
818'		tions of the technical		
	-	s, opinions, judgments,		
EON	lusions, a	and recommendations.		
ave revi	ewed the	subject project documen	t dated, in accordance	•
			, in accordance	e with the noted scope and a
			al reviewed is professionally mments have been discussed wi	
	DIES S	IFV I FWFR		DATE
	ION Signif		ed between the reviewer and au	thor(s) have been resolved
	RESPOR	S:BLE		
				DATE

(Instruction See Over)

FIGURE 4-2
TYPICAL PEER REVIEW
DOCUMENTATION FORM
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

SECTION 5

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

Measurement data for this project will consist of water level, pH, conductivity and temperature measurements to be performed by the site investigation team, and laboratory chemical analyses to be performed by the analytical services contractor. The amounts and types of data to be collected are defined in Volume 1-Investigation Work Plan. Table 5-1 summarizes the Facility Investigation quality assurance objectives for precision, and accuracy, and reporting units for field measurements. Mechanisms for checking precision and accuracy are described in Section 14. Quality assurance objectives for laboratory analyses are contained in Volume 6-Analytical Services Quality Assurance Manual. Those objectives may be modified after Media Protection Standards have been developed for the site.

Data will be sufficiently complete, representative and comparable to allow characterization of site conditions, such that the Public Health and Environmental Risk Evaluation and Corrective Measure Study can be conducted. Hardware and calibration procedures will be used consistently throughout the Facility Investigation so that data collected during the investigation are comparable.

Environmental samples characterize only a finite portion of a dynamic system at one point in time. Because of this, it is difficult to assess the representativeness of a given datum. Sampling, analytical and decontamination procedures have been designed to maximize confidence in data representativeness.

TABLE 5-1 SUMMARY OF FIELD MEASUREMENT QUALITY ASSURANCE OBJECTIVES **CIBA-GEIGY FACILITY** CRANSTON, RHODE ISLAND

Field Measurement (method)	Precision (standard deviation)	Accuracy	Reporting Units
pH (electrometric)	± 0.50 pH units	+ 0.10 pH units	Standard units
Conductivity (electrometric)	± 5.0% of scale	± 10% of standard	umhos/cm
Temperature (electrometric)	<u>+</u> 1.0°C	<u>+</u> 0.5°C	degrees Centigrade
HNU Model PI-101	Not applicable because of dynamic conditions	<u>+</u> 2 ppm of standard	parts per million
Water level (electrometric)	<u>+</u> 0.10 ft	<u>+</u> 0.02 ft	feet
Hermit data logger 10 psi transducer 50 psi transducer	Not applicable because of dynamic conditions	+ 0.05 ft + 0.23 ft	feet feet

Notes:

psi = pounds per square inch umhos/cm = micromhos per centimeter (1) (2)

SECTION 6 SAMPLING PROCEDURES

6.1 OVERVIEW

Sample locations, depth, type and number are presented in Volume 1 - Investigation Work Plan. Sampling procedures described below will be followed during the conduct of the Facility Investigation.

If unforseen circumstances necessitate major deviations from the procedures described below, the USEPA Project Manager will be notified. Change will be subject to USEPA approval and documented in writing (see Section 17).

6.2 SAMPLE COLLECTION TECHNIQUES

6.2.1 Boring Procedures

Geotechnical borings will be advanced to facilitate split-spoon sampling and to accommodate the installation of monitoring wells. Split-spoon sampling provides information on the geologic conditions (stratigraphy) associated with the facility, and monitoring wells are necessary to obtain ground water samples and hydrologic information. The locations and depths of the borings are presented in Volume 1 - Investigation Work Plan.

Borings will be advanced using power drilling systems such as truck or skid mounted rigs. Hollow stem auger procedures are preferred and will be used whenever possible. Mud rotary procedures may be utilized if site conditions render augering inefficient or ineffective. Running sands below the water table are one such condition. Care will be exercised to reduce the potential for vertical cross contamination during drilling. If thick, and laterally continuous, low permeability units (i.e., clayey deposits) are encountered then double casing drilling procedures will be employed. The need for double casing will be based on

the professional judgement of the field geologist. The following procedures are applicable to hollow auger and mud rotary methods:

- o The Site Manager or his/her designee will review the scope of work with the drilling contractor to ensure that proper equipment and materials are available, and that the field operations and health and safety requirements are understood;
- o The location of underground and above ground utility lines will be determined before drilling begins;
- o The field geologist will locate (with the assistance of a surveyor, if necessary) and stake or mark each proposed boring location;
- A geologist will be on site during all drilling operations to inspect soil samples and to maintain an accurate geologic log for each boring (see Section 6.2.1.3). The geologist will be responsible for ensuring that the drilling performed by the contractor is in accordance with the work proposed herein. Non-technical information regarding the boring activities will be recorded in the field notebook (see Section 6.4) by the field geologist;
- o All depths and lengths will be measured and recorded to the nearest 0.1 feet.
- o Ambient air monitoring will be performed by the field geologist during drilling to characterize the air quality for health and safety purposes, and to identify potential emissions. Air monitoring instrument(s) and action levels based on air monitoring data are presented in Volume 4 Health and Safety Guidelines. Readings from the instrument will be recorded on boring logs by the geologist;

- o Standard penetration tests will be performed, and split-spoon samples collected in accordance with ASTM-D-1586-84;
- o Split-spoon samples will be collected continuously to a depth of 20 ft and at 5 ft intervals thereafter;
- o Drilling equipment will be decontaminated before and between each boring as described in Section 6.5; and
- o Drilling spoils will be handled in accordance with the procedures described in Section 6.5.
- 6.2.1.1 Split-Spoon Sampling Procedures. Soil samples will be collected from the borings advanced during Phase I of the Facility Investigation using split-spoon sampling techniques. Standard penetration tests will be performed and split-spoon samples will be collected in accordance with ASTM-D-1586-84. Generally, standard (2 ft long; 2 inch diameter) spoons will be used for sample collection. Larger diameter spoons (2 ft long; 3 inch diameter) may be used at selected sampling intervals. If recovery in a split-spoon is of insufficient quantity for analysis, then the material from above and/or below the intended sample horizon may be used to augment the sample volume. The following procedures will be used during this investigation:
 - Samples will be examined and saved in glass jars with screw-cap lids. Representative soil will be saved from each split-spoon sample. Soil for this purpose may not be available after the other sample requirements (i.e., samples for chemical and geotechnical analysis) have been satisfied. If changes in soil type are observed within a single split-spoon sample then representative subsamples from each soil type will be saved. All sample jars will be stored on-site for the duration of the Facility Investigation.

- o Soil samples will be classified in the field by the field geologist site using the methods described in Section 6.2.1.2.
- o The split-spoon samplers will be decontaminated before each use as described in Section 6.5.
- o Soil samples for laboratory chemical analysis will be transferred from the split-spoon sampler to the laboratory prepared sample containers using a stainless steel trowel which will be decontaminated before each use as described in Section 6.5.
- o Samples for laboratory chemical analysis will be collected (transferred) first, followed by samples for geotechnical analysis followed by samples for on-site storage.
- o Headspace analysis of organic vapors within filled sample jars will be conducted in the field.
- o Selected soil samples from the borings will be analyzed for the physical parameters specified in of Volume 1 Investigation Work Plan. Those samples will be stored and transferred in appropriate containers supplied by the geotechnical laboratory.
- o Test borings not intended for monitoring well installation will be backfilled with a cement-bentonite grout.
- o Excess sample material will be handled in accordance with the procedure described in Section 6.5.

Although most of the subsurface soil samples will be collected using splitspoon sampling techniques, a limited number of samples may be collected with either a thin wall (Shelby) tube sampler or Denison tube sampler. Those samplers are designed to retrieve undisturbed samples suitable for laboratory permeability testing. 6.2.1.2 <u>Soil Classification Procedures</u>. Soil descriptions will be based on observations of soil collected in the split-spoon sampler, soil cuttings (drilling spoils), or trimmings from tube samples. The description and classification of soil samples will be done by the field geologist during the drilling activities. Soil classification will be included on the boring logs (see Section 6.2.1.3).

The sequence of describing a soil sample will be as follows:

- 1. Unified Soil Classification Symbol (ASTM D-2487-85);
- condition of soil, i.e., density (coarse-grained soils) or consistency (fine-grained soils);
- 3. color;
- 4. descriptive adjective for main soil component;
- 5. main soil component;
- 6. descriptive adjective for minor soil component;
- 7. minor soil component;
- 8. miscellaneous descriptions;
- 9. water content descriptive term;
- 10. geological name, if known, or other names (in parentheses); and
- 11. other project specific classifications (i.e., sample number, duplicate sample designations).

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- 6.2.1.3 <u>Boring Log Preparation Procedures</u>. A legible, concise, and complete record of all significant information pertaining to drilling and sampling operations for each boring will be maintained concurrent with the advancement of the hole. That information will be recorded by the field geologist on the boring log. A typical boring log form is shown on Figure 6-1. Required information on the boring log includes the following:
 - o classification and description of soil samples;
 - o depth or elevation of strata changes;
 - o depth or elevation of water table;
 - o number of blows per 6 inches of penetration of the split-spoon sampler during the standard penetration test;
 - o location and identification number of samples;
 - o depth and type of casing;
 - o sample recovery;
 - o change in color of drilling fluid (if applicable) and characteristics of soil cuttings;
 - o organic vapor measurements;
 - o difficulties, if any, associated with drilling;
 - o date(s) of boring operations; and,
 - o name of person preparing the boring log.

Additional types of information other than those listed above will be recorded in the field notebook (see Section 6.4).

6.2.2 Test Pit Excavation Procedures

Exploratory test pits will be excavated to facilitate soil sampling and to evaluate the shallow subsurface material. Test pits will be dug using a backhoe. The locations and depths of the test pits are presented in Volume 1 - Investigation Work Plan. The following general procedures apply to test pit excavation.

- o The Site Manager or his/her designee will review the scope of work with the excavation contractor to ensure that the proper equipment is available and that the field operations and health and safety requirements are understood;
- o The location of underground and above ground utility lines will be determined before excavation begins;
- o The field geologist will locate (with the assistance of a surveyor, if necessary) and stake or mark each proposed test pit location;
- A geologist will be on site during all excavation operations to collect soil samples for laboratory analysis and to maintain an accurate log for each test pit. The geologist will be responsible for ensuring that the excavation performed by the contractor is in accordance with the work proposed herein. Non-technical information regarding the excavation activities will be recorded in the field notebook (see Section 6.4) by the field geologist;
- o All depths and lengths will be measured and recorded to the nearest 0.1 ft.

- o Ambient air monitoring will be performed during excavation to characterize the air quality for health and safety purposes, and to identify potential emissions. Air monitoring instrument(s) and action levels based on air monitoring data are presented in Volume 4 Health and Safety Guidelines. Readings from the instruments will be recorded in the test pit log by the field geologist;
- o The geologist will describe any changes in lithology, color, or detectable odor of subsurface materials, and will note ground water level data on the test pit logs;
- o The test pit will be backfilled upon completion.
- o Excavated material will be handled in accordance with the procedures described in Section 6.5.
- **Soil Classification Procedures.** Soil descriptions will be based on observations by the field geologist site of the in-situ material comprising the test pit walls and material retrieved with the backhoe. Procedures for classification and description of test pit soils will be the same as those described in Section 6.2.1.2.
- 6.2.2.2 <u>Test Pit Log Preparation Procedures</u>. A legible, concise, and complete record of all significant information pertaining to excavation and sampling operations for each test pit will be maintained by the field geologist concurrent with the excavation of the test pit. Required information on the test pit log will include the following:
 - o description of material encountered;
 - o depth or elevation of strata changes;
 - o organic vapor measurements;
 - o location and identification number of samples;
 - o depth or elevation of water table;

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- o date(s) of test pit operations; and
- o name of person preparing test pit log.

A typical test pit log form is shown in Figure 6-2. Information regarding test pit operations, other than the types listed above, will be recorded in the field notebook (see Section 6.4).

6.2.2.3 Soil Samples from Test Pits. Soil samples from test pits will be retrieved from the side wall of the excavation, the bucket of the backhoe or the soil stockpile. Test pits will generally not exceed 10 ft in depth. Shallow soil samples (less than 3 ft deep) may be collected from the wall of the test pit. Samples from the side wall of the excavation will be scraped with a laboratory cleaned stainless steel trowel into a stainless steel tray and transferred to the laboratory prepared sample containers with the stainless steel trowel. samples taken at depths exceeding 3 ft will be collected from the backhoe bucket. Samples will be taken from the center of the bucket to obtain material that has not contacted the bucket and has been minimally disturbed. If sufficient material of interest can not be obtained from the bucket of the backhoe and/or the wall of the test pit then excavated material temporarily stored in a stockpile will be sampled. Material for laboratory chemical analysis will be retrieved from the stockpile and transferred either directly to the laboratory containers or temporarily stored in a stainless steel tray.

The backhoe and stainless steel trowels and trays will be decontaminated according to the procedures described in Section 6.5. Test pit locations, soil sampling depths, and sample numbers are discussed in Volume 1 - Investigation Work Plan.

6.2.3 <u>Surficial Soil Sampling</u>

Surficial soil samples (i.e., those not retrieved from boreholes or test pits) will be collected at the locations and depths indicated in Volume 1 - Investigation Work Plan. Prior to sampling, the location will be cleaned of debris and

vegetation. A steel spade will be used to dig a small excavation at each sampling point. The samples will be scraped from the side wall of the excavation with a stainless steel trowel and transferred to the appropriate laboratory prepared sample containers, or temporarily stored in a stainless steel tray. The spade, stainless steel trowels and tray will be decontaminated in accordance with the procedures discussed in Section 6.5.

6.2.4 Monitoring Well Installation Procedures

Monitoring wells will be installed to facilitate ground water sampling and to accommodate aquifer testing. Ground water sampling/analysis and aquifer testing provide information on the subsurface hydrogeologic conditions associated with the facility. Monitoring wells will be constructed with stainless steel screen and riser pipe. The following procedures apply to monitoring well installation.

- o The Site Manager or his desginee will review the scope of work with the drilling contractor to ensure that proper equipment and materials are available, and that the field operations and health and safety requirements are understood;
- Well casing and screen will be installed by suspending pipe no less than 1 foot above the bottom of the borehole and attaching additional lengths of threaded casing. The screen will be installed at the depth specified by the field geologist;
- A primary filter pack will be installed around the well screen. The filter pack will extend a minimum of 1 foot below and 2 feet above the screen. The primary pack will be sized to be consistent with the screen slot size. The secondary filter pack will extend a minimum of 1 foot above the primary pack and will consist of fine sand. The filter packs will be emplaced with a tremie if deemed necessary by the field geologist;

- o An annular seal will be installed above the secondary filter pack by pouring bentonite pellets from grade along the outside of the riser pipe. The bentonite pellet seal will be a minimum of 2 feet in vertical thickness;
- O Cement/bentonite grout will be installed from above the bentonite pellet seal to grade by the tremie method. Grouting is necessary to minimize vertical migration of water within the former annular space and to increase the integrity of the riser pipe. Care will be taken to avoid disturbing the bentonite pellet seal by initially pumping the grout at low pressure with the tremie pipe set sufficiently above the pellets;
- o A continuous pour concrete cap and well apron will extend below the frost limit to protect the casing. The casing will be marked with identifying decals and surveyed. A locking device will be installed to prevent unauthorized entry or vandalism of the well.

The field geologist inspecting well installation operations will complete an installation form for each well. An example of a monitoring well installation form is shown in Figure 6-3. Details of a typical unconsolidated stainless steel monitoring well are depicted on Figure 6-4.

6.2.4.1 <u>Well Development Procedures</u>. Wells will be developed to improve the hydraulic communication between the formation and monitoring wells and to help assure that representative ground water samples will be collected. During the drilling process, the side of the borehole may become smeared which substantially reduces the permeability of the aquifer in that zone of the boring and retards the movement of water into the well. In addition, soil may enter the filter pack or temporarily clog the well screen slots during installation of the well materials.

Well development is the process of flushing the interface between the aquifer and the well. In addition, the filter pack and screen slots are cleaned, allowing ground water to flow into the monitoring well with a minimum of retardation. Development is required to (1) restore the natural permeability of the formation adjacent to the borehole, (2) remove clay, silt, and other fines from the filter pack and well screen so that subsequent water samples will not be abnormally turbid or contain undue suspended matter; and (3) remove remnant drilling fluids and contaminants potentially introduced during drilling activities (from the formation, for example).

The development process is best accomplished by causing the natural formation water inside the well screen to be moved vigorously in and out through the screen in order to agitate the clay and silt and move them into the well where they can be removed or lodge them into the sand pack and/or formation. Water other than the natural formation water will not be used due to the possibility of contributing contaminants or otherwise affecting ground water quality. Wells will be developed for a maximum of one hour or until there is a turbid-free discharge from the well. If during development the well goes dry, then one hour of pumping and recharge will be implemented.

Equipment used for well development will be cleaned before each use to prevent possible contamination of the well. Decontamination procedures are detailed in Section 6.5. The following procedures are available for developing monitoring wells.

<u>Surge Block.</u> A surge block is a round plunger with pliable edges (constructed of a material such as rubber belting) that will not catch on the well screen. Moving the surge block forcefully up and down inside the well screen causes the water to surge in and out through the screen, accomplishing the desired cleaning action. Close monitoring of the amount of pressure generated must be made to prevent damaging the well casing or screen.

<u>Air Lift.</u> The air lift method involves pumping compressed air down a pipe placed inside the well casing. Due to its inert characteristic, nitrogen is the preferred gas for air lifting. Pressure applied intermittently and for short periods causes the water to surge up and down inside the casing. Once the desired washing is

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accomplished, continuously applied air pressure is used to blow water and suspended sediments upward out of the well.

Considerable care must be exercised to avoid injecting air directly through the well screen. Air can become trapped in the formation outside the well screen and affect subsequent chemical analyses of water samples and hydraulic conductivity measurements. The bottom of the air pipe will not be placed below the top of the well screen.

Another restriction on the use of air is the submergence factor. Submergence is defined as the height of the water column above the bottom of the air pipe (in feet) divided by the total length of the air pipe. To result in efficient air lift operation, the submergence should be at least 20 percent. This may be difficult to achieve in shallow monitoring wells or wells in which ground water is deep.

Bailer and Pump. A bailer which is heavy enough to sink rapidly through the water can be raised and lowered through the water column to produce an agitating action that is similar to that caused by a surge block. The bailer has the added capability of removing turbid water and fines each time it is brought to the surface. Bailers can be custom-made and can be hand operated effectively in shallow wells.

A pump can be used effectively in wells where recharge is rapid. The type and size of the pump used is contingent upon the well design and associated recharge rate.

The well development procedure(s) to be utilized will be evaluated by the geologist based on the conditions encountered during well installation and the conditions associated with the existing monitoring wells. If procedure(s) that involve removing water from the well are used, then the development water will be handled as described in Section 6.5.

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6.2.4.2 Ground Water Sampling Procedures. Ground water samples will be collected two weeks or more after the wells have been developed. A submersible or surface pump will be used to purge each well prior to sampling. A minimum of three well volumes will be purged by continuous pumping. During pumping the intake will be raised above the dynamic (pumping) water level twice (while the pump is running) to ensure complete evacuation. If the well yield is low, then the well may be pumped dry. Wells that are pumped dry will be allowed to recharge and then pumped again. Pumping and recharge will be carried on for a minimum of one-half hour. The amount of water purged from each well will be recorded in the field notebook by the sampler(s) on site. Water generated during purging will be handled as described in Section 6.5. Static water levels will be measured prior to purging each well.

If a submersible pump is used, it will be decontaminated between purging events by scrubbing the outside of the pump and hose with a non-phosphate detergent/potable water solution and rinsing with potable water. The inside of the pump will be flushed with approximately 20 to 30 gallons of potable water between purgings. If a surface pump is used, a dedicated length of factory-fresh polyethylene tubing will be used for each well. The tubing will be washed (scrubbed) externally with a non-phosphate detergent/potable water solution followed by a potable water rinse. Then the tubing will be flushed internally with potable water.

Wells will not be sampled until they are 80 percent recovered or recovered above the screened interval. Regardless of percent recovery, all wells will be sampled within 24 hours of purging. A laboratory cleaned, dedicated stainless steel bailer with a teflon check valve assembly will be used to collect the ground water samples. The suspension line attached to each bailer will consist of a polypropylene cord. All members of the sampling team handling bailers and suspension cords or filling sample containers will wear surgical gloves during sampling activities.

The method of sampling will be to lower the bailer smoothly into the well to a point approximately opposite the middle of the well screen. At this point, the bailer will be gently worked up and down to ensure that water from that depth will enter the bailer. Substantial agitation of the water column will be avoided as this could result in volatilization of volatile organic compounds. The number of bailerfuls used to fill the sample bottles will be minimized.

The first one or two bailerfuls of water retrieved will be used to fill VOC vials, and provide a sample for the field measurements to be conducted. Subsequent bailerfuls will be used to fill the remaining sample bottles. To minimize the effect of any potential constituent stratification in the water column of the well, a small portion of water will be discharged from the bailer into each sample bottle alternately until all of the bottles are full. Water samples intended to evaluate floating product, if any, will be collected from the top of the water column. Decontamination of ground water sampling equipment is discussed in Section 6.5.

Aquifer Testing Procedures. New and existing monitoring wells that are appropriate for slug tests (based on design and construction criteria) will be tested to estimate formation permeability in the immediate vicinity of each well. Slug tests involve submerging a slug cylinder in the water column of the well (falling head test). The change in water level versus time (the response) is recorded by an electronic pressure transducer and data processor. After the well has recovered, the slug is removed (rising head test) and the response is recorded. The response data will be analyzed by means of an in-house computer program that involves standard analytical solutions for unconfined (water-table) aquifers.

The permeability data combined with the hydraulic gradient and porosity will be used to calculate the rate(s) of ground water flow associated with the facility.

Synoptic static water levels in the existing piezometers and existing and new monitoring wells will be measured at least quarterly during Phase I. Static water levels (and floating product levels, if present) will be measured with reference to

a surveyed point (temporary bench mark) on the riser pipe. Ground water levels will be measured to the nearest hundredth of a foot, using an electrical depth gauge or a weighted tape. Elevations will be reported in feet and referenced to mean sea level.

Decontamination of the aquifer testing equipment will be in accordance with the procedures described in Section 6.5.

6.2.5 Surface Water Sampling Procedures

Surface water samples for chemical analyses will be composited (integrated) along transects across the Pawtuxet River. Samples will be collected by lowering the intake of a peristaltic pump (or equivalent) to the desired depth and 'trawling' across the river. The sample depth will be determined based on results of the physical hydrologic investigation. Factory fresh Tygon tubing will be used for each sample. Water, retrieved directly from the pump outflow, will be temporarily stored in a laboratory prepared container of sufficient volume for the required analyses. The water will subsequently be transferred to the individual laboratory prepared containers. The pump and hose will be flushed with one gallon of distilled/deionized water between samples.

6.2.6 Bed Sediment Sampling Procedures

Samples for laboratory chemical analysis will be collected from the Pawtuxet River bed. The sampling technique selected will be determined based on the results of the preliminary bed sediment evaluation to be conducted during the physical hydrologic investigation. Likely sampling techniques include vibratory coring, split-spoon sampling, and vertical pipe coring. The vertical pipe coring apparatus will probably be a thin-walled tube sampler with a clear plastic liner. Cores would be obtained by manually pushing the tube sampler into the bed. The technique of choice will be presented in the Proposal Addendum and will be based on the conditions encountered during the preliminary evaluation of the bed sediment.

Sample descriptions will be based on the procedures outlined in Section 6.2.1.2. Sampling equipment will be decontaminated as described in Section 6.5. Sample handling and custody procedures will be as described in Sections 6.3 and 7, respectively.

6.3 SAMPLE HANDLING

Samples collected for laboratory analysis will be placed directly into sample containers provided by the laboratory performing the analyses. Necessary reagent preservatives will be placed in the appropriate sample containers by the laboratory prior to container shipment. Sample containers will be shipped to CIBA-GEIGY's consultant not more than five days before the beginning of the sampling event. Completeness of container sets will be verified upon receipt by a member of the sampling team so that deficiencies can be remedied in advance of the sampling event.

Individual sample containers will be sealed by hand tightening container lids. Water sample vials for volatile organic analysis will be filled leaving no headspace. This will reduce the chance for escape of volatiles from the sample. Zero headspace will be checked by inverting the vials and tapping to cause bubbles to rise. If bubbles are present, more sample will be added to displace them.

Soil samples placed in vials for volatile analysis will be tamped down to reduce the amount of pore space in the sample. All other sample containers will be filled to their necks. Once sealed the samples will be placed in ice-filled coolers or a refrigerator. Sample containers, preservation and holding times are summarized in Table 6-1.

Samples will be shipped to the laboratory within 2 days of the time of collection. Daily shipments will be made whenever practical to reduce the possibility that holding times might be exceeded. The laboratory will be notified

in a timely manner to be prepared to receive a shipment of samples. This too will reduce the possibility of holding time exceedance.

Samples will be packed in inert materials to prevent breakage. Coolers will be sealed with tape and secured with a signed custody seal. The custody seal will provide an indication of whether the cooler was opened by unauthorized personnel.

During sampling events partially filled and unfilled coolers will be kept within sight of the sample custodian or secured (locked in a vehicle). The sample custodian will be a designated member of the sampling team.

Sample custody documentation associated with sampling are described in Section 7.

6.4 FIELD NOTEBOOKS

Hardcover bound field books will be used as field notebooks because of their compact size, durability, and secure page binding. The pages of the notebook will be numbered consecutively and pages will not be removed for any reason. Entries will be made in waterproof indelible ink.

Notebooks comprise the documentary evidence for procedures as performed by field personnel. Each entry will be dated, legible, and contain accurate and complete documentation of the individual's or sampling team's activities. The level of detail will be sufficient to explain and reconstruct the operation should legal proceedings require it. Each notebook page will be signed by all personnel making entries on that page.

A standard format will be used to assure that all necessary information is included. The following types of information will be provided for each sampling task as appropriate:

1. Project name and job number.

- 2. Reasons for being on site or taking the sample such as quarterly sampling, resampling to confirm previous analysis, initial site assessment, and so on.
- 3. Date and time of sampling. Include date and time of well bailing for ground water samples.
- 4. Sample identification number.
- 5. Geographical location of the sampling point with reference to site (or other) facilities or a map coordinate system (sketches are helpful).
- 6. Physical location of the sampling point such as depth below ground surface or water surface.
- 7. Description of the method of sampling including procedures followed, equipment used, and any departure from the procedures specified in this Proposal. Volume of water purged and water levels will be included for ground water samples.
- 8. Description of the sample including the type of sample (soil, sludge, water, etc.).
- 9. Results of field measurements such as conductivity, salinity, temperature and, pH.
- 10. Weather conditions at the time of sampling, and previous events which may impact on the representative nature of a sample, for example, heavy rains prior to sampling impoundment waters.
- 11. Photographic information. Briefly describe what was photographed and why, the date and time, the compass direction of the picture, and the number of the negative on the roll.

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- 12. Reference numbers from all serialized forms on which the sample is listed or labels which are attached to the sample, i.e., chain-of-custody forms, airbill numbers, etc.
- 13. Other pertinent observations such as the presence of other persons on the site (those associated with the job or members of the press, special interest groups, or passers-by), actions by others that may affect performance of site tasks.
- 14. Name(s) of sampling personnel and signature of person(s) making entries.

6.5 DECONTAMINATION PROCEDURES

6.5.1 Overview of Decontamination Procedures

Equipment and personnel decontamination areas will be set up in an area determined to be uncontaminated but as near as possible to the work site. Determination of the decontamination areas will be made using site reconnaissance, or other determinative procedures.

6.5.2 Personnel

Decontamination of personnel is discussed in Volume 4 - Health and Safety Guidelines.

6.5.3 Heavy Equipment

Decontamination of large drilling equipment, drilling tools (augers, rods, bits, etc.), and backhoe buckets will be performed to prevent cross-contamination of boreholes, especially those in which ground-water monitoring wells will be established, or test pits from which soil samples will be retrieved for chemical

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analysis. Heavy equipment that may have contacted contaminated material will be cleaned before use by washing with potable hot water under high pressure.

6.5.4 Sampling Equipment

All hand-operated water, soil and sediment sampling equipment will be decontaminated prior to use and will be wrapped in a protective covering and labeled as clean. The following procedure will be used to decontaminate sampling equipment:

- 1. scrub with potable water to remove mud and residue;
- 2. scrub with a detergent-potable water solution or other decontamination solution using a hard bristle brush;
- rinse with distilled/deionized water;
- 4. rinse with pesticide-grade acetone;
- 5. air dry;
- 6. rinse with distilled/deionized water; and
- 7. package and seal equipment in plastic bags or other appropriate wrappings to prevent contamination.

If samples to be collected will be analyzed for metals, then equipment will be rinsed with 10% Nitric Acid after step 3 and rinsed again with distilled/deionized water.

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6.5.5 Handling of Drilling Spoils, Fluids and Extracted Ground Water

Solid drilling spoils will be temporarily stored on site until the results of soil analyses have been validated and evaluated. Subsequent handling of the spoils will be based on those results. For temporary storage, the spoils will be placed on a plastic sheet and covered by a second plastic sheet.

Liquid drilling spoils (e.g., drilling mud) and extracted ground water will be screened with an HNU photoionization detector. If the fluids produce no detectable volatile compounds and contamination is not visually obvious, then the fluids will be discharged on the ground. If contamination is evident, then the fluids will be temporarily stored on site. Subsequent handling will be based on analytical results of composite samples of the stored fluids.

TABLE 6-1 SAMPLING AND PRESERVATION REQUIREMENTS CIBA-GEIGY FACILITY CRANSTON, RHODE ISALND

	•	EPA			Maximum
	Parameter	Method	Container	Preservative	Holding Time **
Liquid	Volatile				
Samples	Organics	SW-846, 3rd ed.	40 ml glass vial	Cool to 4°C	Analyze within 14 days
		Vol 1-B; 8240	with teflon septum	4 drops HC1	
	Semi-volatile	SW-846, 3rd ed.	1,000 ml glass jar	Cool to 4°C	Extract within 7 days
	Organics	Vol 1-B; 8270	with teflon lined lid		Analyze within 40 days
	Metals (except	SW-846, 3rd ed.	200 ml polyethylene	Cool to 4°C	6 months
	CrVI and Hg)	Vol 1-A; 7000 series	or glass	HNO_3 to pH <2	•
	Mercury	SW-846, 3rd ed.	200 ml polyethylene	Cool to 4°C	28 days
		Voi 1-A; 7470, 7471	or glass	HNO_3 to pH <2	
	Pesticides	SW-846, 3rd ed.	1,000 ml glass	Cool to 4°C	Extract within 7 days
		Vol 1-B; 8080			Analyze within 40 days
	PCBs	SW-846, 3rd ed.	1,000 ml glass	Cool to 4°C	Extract within 7 days
		Vol 1-B; 8080	•		Analyze within 40 days
Solid					
Samples					
	Volatile Organics	SW-846, 3rd ed.	120 ml glass vial	Cool to 4°C	Analyze within 14 days
		Vol 1-B; 8240	with teflon septum		•
	Semi-volatile	SW-846, 3rd ed.	500 ml glass jar	Cool to 4°C	Extract within 14 days
	Organics	Vol 1-B; 8270	with teflon lined lid		Recommend analysis within 40 days
	Metals (except	SW-846, 3rd ed.	500 ml glass	Cool to 4°C	6 months
	CrVI and Hg)	Vol 1-A; 7000 series		HNO ₃ to pH <2	

TABLE 6-1 (continued) SAMPLING AND PRESERVATION REQUIREMENTS CIBA-GEIGY FACILITY CRANSTON, RHODE ISLAND

<u>Parameter</u>	EPA <u>Method</u>	Container	Preservative	Maximum Holding Time**
Mercury	SW-846, 3rd ed. Vol 1-A; 7470, 7471	500 ml glass	Cool to 4°C HNO ₃ to pH <2	28 days
Pesticides	SW-846, 3rd ed. Vol 1-B; 8080	500 ml glass	Cool to 4°C	Extract within 14 day Recommend analysis within 40 days
PCBs	SW-846, 3rd ed. Vol 1-B; 8080	500 ml glass	Cool to 4°C	Extract within 14 day Recommend analysis within 40 days

^{**} Holding times begin at time of sample collection.

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FIGURE 6-1
TYPICAL BORING LOG FORM
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

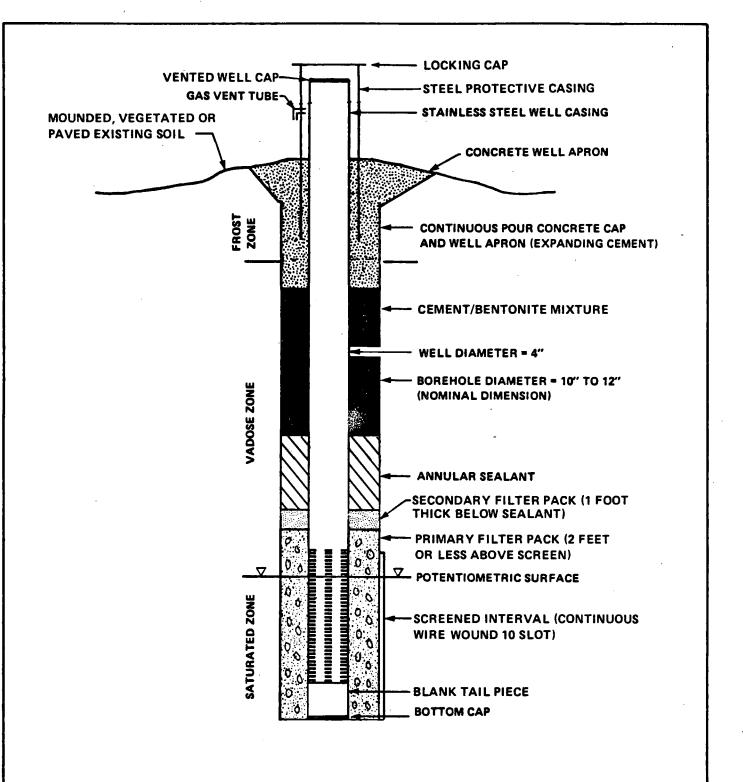
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COORDINATES EXCAVATION CONTRACTOR		FOREMAN		COMP	LETION DEPTH.	FT	APPROX. DIMEN	SION, FT
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				WAT	ER LEVEL, FT	FIRST	COA	IP.
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FIGURE 6-2
TYPICAL TEST PIT LOG FORM
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

INSTALLATION REPORT

PROJECT AND	LOCATION	WELL NO.	ELEVATION DAT	UM PROJECT NO.
DRILLING AGENCY		POREMAN	DATE INSTALLAT	TION DATE INSTALLATION FINISHED
DEVELOPMEN	T EQUIPMENT	GALLONS REMOV	TIME DEVELOPM	ENT TIME DEVELOPMENT COMPLETED
		OG OF MONITOR	ING WELL	
	BORING	TYPE OF	MONITORING WELL	_
DEPTH IN FT	DESCRIPTION	GROUND	ELEV.	TOP OF RISER ELEV.
IEMARKS		L1	3 3	TYPE OF PIPE TYPE OF PIPE TYPE OF BACKFILL AROUND RIBER TOP OF SEAL ELEV. TYPE OF SEAL MATERIAL TYPE OF FILTER MATERIAL SIZE OF OPENINGS DIAMETER OF MONITOR WELL TIP BOTTOM OF MON. WELL ELEV. BOTTOM OF BORING ELEV. DIAMETER OF BORING

FIGURE 6-3
TYPICAL MONITORING WELL
INTALLATION FORM
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND



NOTE:

PRIMARY FILTER PACK IS CHEMICALLY INERT AND SIZED TO BE CONSISTENT WITH SCREEN SLOT SIZE. SECONDARY FILTER PACK IS CHEMICALLY INERT VERY FINE SAND FOR THE PURPOSE OF RETARDING SEALANT OR GROUT INFILTRATING PRIMARY FILTER PACK.

TYPICAL STAINLESS STEEL
MONITORING WELL CONSTRUCTION
CIBA-GEIGY FACILITY CRANSTON, RHODE ISLAND

WOODWARD - CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. SY:	DRS	SCALE:	NONE	PROJ. NO.:	87 X 4660
CK'D. BY:	RJH	DATE:	5 FEB 1988	FIG. NO.:	6-4

SECTION 7 SAMPLE CUSTODY

Chain-of-custody forms will be used to record history of possession of sample containers and, subsequently, samples. Samples will be considered in custody if they are within site of the individual responsible for their security or locked in a secure area. Field sampling personnel are responsible for sample security until they are turned over to the shipper or laboratory. Chain-of-custody forms will be initiated by the laboratory when they issue the sample containers. The forms will be maintained through sample bottle acquisition and sampling by sampling personnel, and will be returned to the laboratory upon submission of samples. Each person (except for couriers) taking possession of the samples will record their name along with the date and time of acquisition. Laboratory chain of custody will be maintained throughout the analytical processes as described in Volume 6 - Analytical Services Quality Assurance Manual.

Sample information pertinent to their analysis will be recorded on the chain-of-custody form. The information will include a sample identification number, sampling location, time of sampling, sample preservatives and analyses to be performed. A typical chain-of-custody form which may be used in this investigation is illustrated in Figure 7-1.

Each sample will be labeled in the field. Information recorded on the label will include the sample identification number, time and date of sampling, sample preservative and analysis to be performed. An example of a typical sample label which may be used in this investigation is illustrated in Figure 7-2.

Entries on labels and forms will be made with permenant ink. Corrections will be made by placing a single line through the incorrect entry and will be initialed by the person making the correction.

FIGURE 7-1
TYPICAL CHAIN-OF-CUSTODY FORM
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

			REQUEST FOR ANAL	YSIS	R/A Control No C/C Control No.	002387
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PURCHASE ORE	DER NO		DATE R	EPONT REQUIRED		
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			PROJEC	CT CONTACT PHONE NO		
Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Progra	ım .	Special Instructions
						·
						
TURNAROUND TIM	NE REQUIRED (Rush m	ust be approved by the Project	Manager)			
	Normal		Nuch (Subject to	rush surcharge)		
POSSIBLE HAZARO	DIDENTIFICATION (P	ease indicate if sample(s) are h	azardous materials and/or suspe	cted to contain high levels of hazerin	us substances)	
Henhezard	_ Flore	sable	Skin intient	Highly Toxic	Other _	
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Sample No). <u></u>			
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Collectors	Name			
Sample Lo	cation			
Sample Ty	pe/Depth/De	scription _		
		<u>,</u>	Præse	~ative
Analyze Fo	·			
Βοπίο	01		_ Filtered	Nonfiltered

FIGURE 7-2
TYPICAL SAMPLE LABEL
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

SECTION 8 CALIBRATION PROCEDURES

8.1 OVERVIEW OF CALIBRATION PROCEDURES

Devices and equipment used to perform testing or data recording will be calibrated prior to use. Documentation will include identification of the specific device or equipment calibrated, date, reference standard, results adjustments or repairs which should be made, and the signature of the person performing the calibration. If the equipment is adjusted or repaired, it will be recalibrated; the calibration will be documented and adjustments/repairs noted.

CIBA-GEIGY's consultant employs a full-time technician responsible for maintaining field equipment and assuring that equipment is calibrated to manufacturer's specifications. The equipment will be either calibrated in-house using manufacturer's calibration standards and reagents or will be sent to the manufacturer to be factory calibrated. Calibration checks and adjustments, if necessary, will be performed both before and after equipment goes into the field.

Calibration procedures for field equipment are summarized in the following sections. Manufacturer's operation manuals, including detailed calibration procedures are on file with CIBA-GEIGY's consultant.

8.2 HNU

The procedure for calibration of the instrument from a pressurized container gas standard is to connect one side of the "T" to the calibration gas, another side of the "T" to a rotameter and the third side of the "T" directly to the 8" extension on the photoionization probe. Crack the valve of the pressurized container until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample required for detection and the flow in the rotameter indicates an excess of sample. Now adjust the span so that the instrument is reading the exact value of

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the calibration gas. (If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted, if necessary.) The calibration gas to be used for this investigation is a 100 ppm isobutylene/air mixture supplied by Instrument Services, Inc.

8.3 S-C-T METER

The S-C-T (salinity, conductivity and temperature) meter does not have a user-designated calibration knob. The meter is field checked daily (or more often if the operator suspects incorrect readings) prior to use with 200 and 2000 umho potassium chloride solutions supplied by Biopharm, Inc. The temperature is checked with a precision mercury thermometer at ambient room temperature. If the standards are not within 10 percent of the true value, the instrument is not used and returned for repair and calibration by the equipment technician.

8.4 pH METER

The initial calibration is performed with three standard buffer solutions set at pH 4.0, 7.0 and 9.0. The calibration is checked daily (or more often if the operator questions the response time or results) with commercially prepared standards supplied by Biopharm, Inc. If the check sample is out of range, the meter is recalibrated. If the meter cannot be brought within ±0.1 pH standard units of the standard, it is returned to the laboratory technician for repair.

8.5 WATER LEVEL METER

Water level meters will be calibrated either once a week, after replacing the sensor or after possible stretching or kinking of the cable between the sensor and readout. Calibration of the unit consists of verifying that the probe is responding to water and verifying that the scale markings on the tape correspond with calibrated engineering tape within 0.02 ft. If the scale is incorrect and cannot be compensated for by the addition or subtraction of a constant, the meter will be returned to the laboratory technician for repair.

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SECTION 9 ANALYTICAL PROCEDURES

Laboratory quality assurance is the responsibility of the contract laboratory. Laboratory personnel involved in analyses of samples for this project are expected to comply with the procedures detailed in Volume 6 - Analytical Services Quality Assurance Manual.

SECTION 10 DATA REDUCTION, VALIDATION AND REPORTING

Data reduction procedures to be used by CIBA-GEIGY's consultant will apply to all types of data, including laboratory data, field sampling data, in-situ testing data, field survey data, and test boring data. Data reduction techniques will include systematic ordering of data components, graphical or tabular presentation, summarization, and calculations, as appropriate.

Validated field duplicate and laboratory replicate measurements of a single sample will be averaged prior to further data reduction. Records of actual field observations will not be changed in the course of data reduction. Even if they contain inaccuracies, unaltered originals of field-collected data will be retained.

The Project Manager will select qualified reviewers to ensure that all data records are complete and accurate. Any discrepancies will be discussed and resolved with the originator. Data reduction will be verified by comparing raw data to the original source, by verifying engineering calculations, and by confirming data summaries.

Each type of data will go through two reviews. Reviews will be performed by two different members of the project staff. All changes will be initialed and dated by the data reviewer. When all data have been verified to the satisfaction of the first level reviewer, the data sheet will be signed and dated.

The second level of review will consist of a ten percent random spot check for data agreement with the original source and accuracy. After the second level of review has been completed, the reviewer will sign and date the data sheet. Data will not be distributed until both levels of review have been completed. The above procedure will also apply to any visual presentations of data. However, graphic representations created using computer software from data which has

already been quality checked will only require review by the project staff for accuracy. The Project Manager will be responsible for determining the appropriateness of any graphics, including maps and drawings. Maps or drawings will only be created subsequent to validation of data to be represented. After a map or drawing has been completed, it will then be subjected to the same two level review system as are other data.

Data validation for field measurements will consist of reviewing precision and accuracy measurements to check for compliance with prescribed data quality objectives. Where those objectives have not been met, the data will be qualified.

Data validation of laboratory reports by CIBA-GEIGY's site investigation consultant will be based on the acceptance criteria of the appropriate methodology (e.g., Publication SW-846 for analysis of soil samples) as well as the latest Statement of Work (SOW) by the USEPA for evaluation of laboratory data. All data in laboratory reports will be evaluated under those guidelines and carefully checked and corrected for any transcription errors noted during the data review. Any pages which required corrections will be marked as such and corrected pages will be submitted by the laboratory and inserted into the reports. Quality assurance/quality control information to be evaluated in each report includes the following:

- o sample holding times;
- o sample identification;
- o method blank analyses;
- o GC/MS tune summaries:
- o dates and times of calibration;
- o target and non-target analyte summaries;
- o minimum detection limits:
- o accuracy and precision for spiking compounds; and
- o surrogate recovery.

SECTION 11 INTERNAL QUALITY CONTROL CHECKS

Internal quality control checks for field sampling techniques will include field blanks, trip blanks and field duplicate samples. Field blanks will be collected at the rate of one per 20 samples of a given matrix. Trip blanks will be analyzed at the rate of one per sample shipment sent to the laboratory. Field duplicate samples will be collected at the rate of one per 20 samples collected of a given matrix. Field duplicates and field blanks will be analyzed for the same parameters as the corresponding samples. Trip blanks will be analyzed for the same volatile organic compounds as the samples which they accompany. If no volatile organics are being analyzed, trip blanks will not be analyzed.

Internal quality control checks for field measurement instruments will be done through the periodic calibration of the instruments as described in Section 8 and by checking the reproducibility of the measurement by taking multiple readings as described in Section 14.

SECTION 12 PERFORMANCE AND SYSTEM AUDITS

Prior to the execution of the Facility Investigation a system audit was performed. That audit consisted of peer reviews of this RCRA Facility Investigation Proposal by designated reviewers.

After the Facility Investigation has begun, performance audits will be conducted by the Quality Assurance Officer to verify compliance with the Project Quality Assurance Plan. Two on-site audits will be conducted during both Phase I and Phase II of the Facility Investigation. Office audits will be conducted monthly. Performance audit findings will be submitted to the Project Manager once every two months. If deficiencies are noted, a non-conformance report will be initiated by the Quality Assurance Officer (see Section 15).

SECTION 13 PREVENTIVE MAINTENANCE

Preventive maintenance of field equipment and measurement devices will be performed regularly. CIBA-GEIGY's consultant employs a full-time technician who is responsible for maintenance of equipment. Routine maintenance is performed before equipment is issued. More extensive maintenance procedures are carried out in accordance with the manufacturer's recommendations.

CIBA-GEIGY's consultant maintains a Field Sampling Van which is stocked with sampling equipment, spare parts, and tools. The van will be used in most sampling efforts during the Facility Investigation. Critical spare equipment kept in the Van includes an extra centrifugal pump, an extra submersible pump, and extra laboratory-cleaned bailers and decontaminated trowels. Bailers and trowels will be transported in a rooftop carrier, away from gasoline vapors.

SECTION 14 SPECIFIC PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, REPRESENTATIVENESS AND COMPLETENESS

The precision of pH, temperature, conductivity, and water level measurements will be assessed by collecting three duplicate measurements per every 20 samples. The three measurements will be used to calculate a standard deviation. If the standard deviation is greater than the precision objective (see Table 5-1), then the instrument will be recalibrated.

After 20 samples have been measured with a given field measurement device, the instrument will be checked for accuracy against a standard. Table 14-1 lists the standards to be used with each of the field instruments. If the instrument does not read within the prescribed accuracy objective (see Table 5-1), it will be recalibrated.

TABLE 14-1 FIELD INSTRUMENT STANDARDS CIBA-GEIGY FACILITY CRANSTON, RHODE ISLAND

T				•
Inci		ממו	an	т.
Inst	LL U		CII	

pH meter

Conductivity meter

Thermometer

HNU

Water level meter

Hermit data logger

Standard

pH 4.01, 7.00 and 10.00 powder pillows supplied by HACH Co.

85.47 and 1000 mg/L NaCl solutions supplied by HACH Co.

NBS thermometer

100 ppm isobutylene/air mixture supplied by Instrument . Services, Inc.

Calibrated steel tape

Calibrated steel tape

SECTION 15 PROCEDURES FOR CORRECTING DEFICIENCIES

Corrective Procedures may be initiated by any project team member at any time by notifying the Project Manager in writing of the nature and potential impact of an observed deficiency. Corrective Procedures may also be initiated as a result of other Quality Assurance activities, including performance audits and system audits.

Specific Corrective Procedures for irregularly occurring problems, such as instrument malfunctions, will be defined as the need arises. However, in any case, the appropriate Task Leader will be immediately notified, will investigate the extent of impact, will implement any immediately appropriate Corrective Procedures, and will notify the Project Manager and the Quality Assurance Officer in writing.

Non-conformance reports for deficiencies discovered during performance or system audits will be initiated by the auditor. The Project Manager and the Quality Assurance Officer will be notified in writing of observed nonconformances requiring Corrective Procedures. CIBA-GEIGY will be notified and advised of Corrective Procedures planned to prevent recurrence.

Data collection activities affected by the reported deficiencies may be stopped while the nonconformance is investigated by the Project Manager and the appropriate Task Leader. If, in the opinion of the Project Manager, the deficiency does not significantly affect the quality or use of the data, the activity may continue pending resolution of the nonconformance. The basis for such decisions will be documented prior to resumption of work.

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In response to a non-conformance report, the Project Manager will propose an appropriate Corrective Procedure, which will be approved by the Quality Assurance Officer and the Senior Responsible Professional. The Quality Assurance Officer will verify and document that appropriate and timely action was taken.

SECTION 16 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The Project Manager will receive a Quality Assurance Report from the Quality Assurance Officer once every two months. As appropriate, those reports will include an assessment of data accuracy, precision, and completeness, results of audits, significant Quality Assurance problems and proposed solutions and resolution of any previous problems. Possible modifications to project schedule and the Project Quality Assurance Plan will be addressed in those reports.

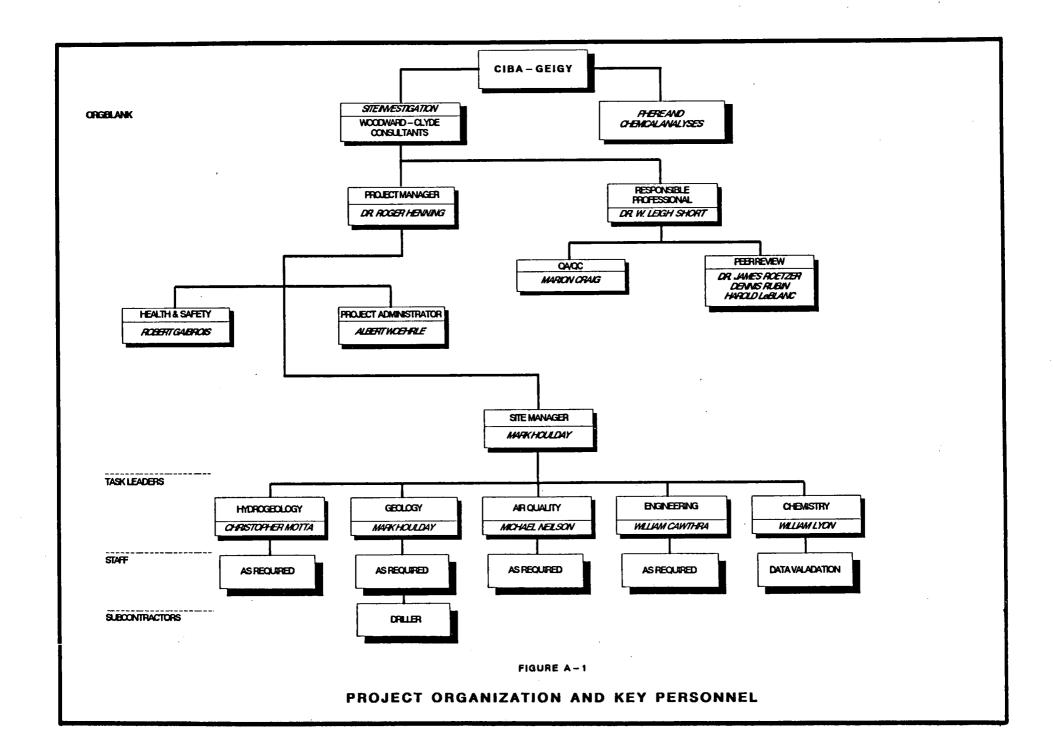
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SECTION 17 PROCEDURES FOR DOCUMENTING CHANGE

Conditions encountered in the field often require change in protocol to accommodate those conditions. Other types of change may also occur during the Facility Investigation.

Significant changes will be subject to approval by the USEPA and will be documented with a change control form. That form will include the nature of the change, the reason for the change, the ramifications of the change and any actions that may be necessary to account for deficiencies produced by the change. The form will be authored by the person or persons who implemented or who will implement the change and signed by the Project Manager after approval by CIBA-GEIGY. The form will be submitted to the USEPA for review and approval.

Appendix A



WILLIAM M. CAWTHRA

environmental engineering process engineering chemical engineering water treatment

EDUCATION

New Jersey Institute of Technology: B.S., Chemical Engineering, 1956

REGISTRATION

Professional Engineer: New Jersey; Louisiana

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Project Engineer, 1987-date Stauffer Chemical Company, Manager, Environmental Engineering, 1974-1987 Witco Chemical Company, Senior Process Engineer, 1964-1974 Permutit Company, Process Engineer, 1961-1964 Honeywell, Industrial Sales Engineer, 1957-1961

REPRESENTATIVE EXPERIENCE

Mr. Cawthra is a licensed Professional Engineer with over 30 years of technical and managerial experience. He has a Chemical Engineering Degree as a base, supplemented by instrumentation and water treatment experience. Mr. Cawthra has combined process design and environmental engineering skills with supervision responsibilities of multi-discipline groups.

Since joining Woodward-Clyde, Mr. Cawthra has coauthored conceptual designs for two superfund sites, was responsible for a feasibility study which resulted in "no further action" required by the client, and prepared a remedial action plan for a former coal gas plant. He was also Project Manager on the cleanup of a RCRA storage facility, and supervised a study on improvements to RCRA waste management at a major university complex.

From 1980 through 1987, Mr. Cawthra was responsible for the technical and administrative management of the Environmental Engineering Department at Stauffer Chemical Company. He supervised up to seven senior engineers by planning, directing and allocating assignments, primarily in design of pollution control facilities for new and existing plants. Responsibility for a three-man Safety Engineering Group was added in late 1980. Prior to 1980, he served as Senior Environmental Engineer responsible for coordination of all environmental project planning, permitting, and conceptual design of spill control, solids disposal, air abatement, and deep well pretreatment of two major pesticide manufacturing complexes.

Woodward-Clyde Consultants

Other involvements for Mr. Cawthra included: hazardous waste minimization, RCRA pond design, ground water remediation projects, waste brine incineration designs, neutralization design, dust/odor control, spill control/storm water recycling, and preparation of an RI/FS for a Superfund site. He acted as Project Engineer for a major ground water intercept/treatment system, made conceptual designs for regional hazardous waste treatment facility, conducted studies/air modeling for toxic plant emissions impact on surrounding communities, and contributed to a company manual for preparation of RCRA Part B permits.

Ss Senior Process Engineer at Witco Chemical Company from 1964 through 1974, Mr. Cawthra prepared PFDs/P&IDs for several organic plants, including designing and sizing process equipment. He prepared detailed designs for a white oil/transformer oil and sulfonates plant for India, including mechanical check and operator training. He assisted on the start-up of an activated carbon manufacturing plant, sulfonates plant, powdered detergent plant, and carbon dust reconstitution plant. He made spill control/storm water collection studies and contributed on the design for two large plants plus SO₂ abatement of a third.

As Process Engineer at Permutit Company from 1961 through 1964, Mr. Cawthra prepared designs for municipal and industrial water treatment plants including filters, clarifiers, softeners, and degasifiers.

Ss Industrial Sales Engineer at Honeywell, he designed and sold instrumentation control systems, pneumatic, electronic, flow, temperature, and pressure control valves.

PROFESSIONAL AFFILIATION

American Institute of Chemical Engineers; Environmental and Safety Subsections.

MARION E. CRAIG

hazardous waste investigations structural geology

EDUCATION

Queens College, C.U.N.Y.: M.S., Geology, 1988 Queens College, C.U.N.Y.: B.A., Geology, 1980

REGISTRATION

Registered Professional Geologist #876 (Arkansas)

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Assistant Project Geologist, 1989-date Woodward-Clyde Consultants, Senior Staff Geologist, 1987-1989 Woodward-Clyde Consultants, Staff Geologist, 1984-1987 Research Foundation of the C.U.N.Y., Adjunct Lecturer, 1980-1982 Rockefeller University, Laboratory Technician, 1977-1982

REPRESENTATIVE EXPERIENCE

Ms. Craig has participated in several engineering geology and hazardous waste investigations. Her experience in engineering geology has involved the inspection of rock tunnels, foundation and sewer excavations, and surface and subsurface mapping for design-phase construction projects in New Jersey and New York. Field tasks involved with these jobs included soil boring, rock coring, and piezometer installation.

Ms. Craig has worked on several hazardous waste investigations in New Jersey and New York. She has recently prepared Field Sampling Plans for NPL sites in New Jersey and Remedial Investigation reports for New Jersey Superfund sites. Her primary field duties include well installation, water sampling, and soil sampling.

Ms. Craig has worked as a site manager on several water and soil sampling operations on hazardous waste sites. Her duties included all interactions with the contracted analytical laboratory from ordering of sampling equipment to sample shipment and the supervision of sampling personnel.

Ms. Craig has completed courses in safety training and has worked in Level C and D protection equipment. She is also fully trained to work in Level B protection.

MARION E.CRAIG page 2

PROFESSIONAL AFFILIATIONS

Association of Ground Water Scientists and Engineers Sigma Xi

PUBLICATIONS

The Effects of Silica Diagenesis on the Evolution of Deformational Structures in the Havallah Sequence, Nevada, Geological Society of America, Abstracts with Programs, v. 16, No. 6, p. 451, 1984.

Diagenetic and Deformational Structures in Cherts of the Havallah Sequence, Nevada. M.A. Thesis, Queens College, C.U.N.Y., 1988.

Diagenetic Controls on the Structural Evolution of Siliceous Sediments in the Golconda Allochthon, Nevada. Journal of Structural Geology, v. 9, No. 4. pp. 403-417, 1987.

ROBERT G. GAIBROIS

project management waste management geotechnical engineering ground water assessment health and safety

EDUCATION

Cornell University: M.E., Civil Engineering (Soil and Foundation Engineering), 1974
Cornell University: B.S., Civil Engineering, 1973

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Staff Engineer to Project Engineer, 1974-date

REPRESENTATIVE EXPERIENCE

Mr. Gaibrois has managed engineering, hydrogeologic, geophysical and environmental investigations at numerous sites since joining Woodward-Clyde Consultants. These programs have included site investigation, engineering analysis, remedial design and construction inspection activities.

For the past eight years, Mr. Gaibrois has been involved in waste management Projects throughout the northeastern U.S. These assignments have included ground water contamination studies and remedial action programs for industrial facilities, municipal water supply wells, and leaking underground storage tanks containing petroleum products and other chemicals. Mr. Gaibrois has experience in the planning and performance of soil, surface water, sediment, air, septic and ground water sampling programs in accordance with stringent Federal and State Quality Assurance/Quality Control requirements.

Mr. Gaibrois has recently served as Project Engineer responsible for Field Investigations and the preparation of the Remedial Investigation and Feasibility Study(RI/FS) for the Waldick Aerospace Devices site in Monmouth County, New Jersey. This site is a U.S. Environmental Protection Agency National Priorities List Hazardous Waste Site and is being investigated under the Superfund hazardous waste cleanup program. Samples collected from the site have indicated high levels of chromium, cyanide, tetrachloroethene and trichloroethene. Mr. Gaibrois was responsible for the preparation of the technical specifications, geophysical programs including terrain conductivity and resistivity techniques, vadose zone gas extraction and sampling, contaminant delineation, and geotechnical aspects of the feasibility study. Monitoring well and test boring programs were performed under the supervision of Mr. Gaibrois. Work at the site was performed at Level B (self-contained breathing apparatus), Level C (air purifying respirator) and

Level D protection levels. Mr. Gaibrois has also participated in other investigations performed under the Superfund program including the LiPari Landfill, Vestal Wellfield, Lang Property, D'Imperio and Metaltec/Aerosystems sites.

Mr. Gaibrois has performed investigations and site remediation at many facilities where contaminants from leaking underground and aboveground storage tanks have impacted upon soil and ground water quality. In northern New Jersey, over 1000 gallons of toluene and xylene leaking from underground tanks went undetected for several months at a chemical facility. Specifications for tank removal and excavation of contaminated soil were prepared by Mr. Gaibrois for several underground storage tanks which had leaked. Mr. Gaibrois is currently managing the preparation of an underground storage tank management plan for a pharmaceutical company in which a WCC underground tank economic model will be used to establish the optimal tank replacement and monitoring program for more than thirty underground storage tanks.

Mr. Gaibrois is currently the Project Manager for a RI/FS for the Montgomery Township Housing Development/Rocky Hill Municipal Wellfield site in Somerset County, New Jersey. In this capacity, Mr. Gaibrois has been responsible for the development of a work plan, Health and Safety plan, QA/QC project management plan, geophysical investigation, lineament analysis, conduct of the remedial investigation, feasibility study, and conceptual design, and presentations before the public and local elected officials. Previous investigations at the five square mile site have indicated the presence of PCBs, methylene chloride and trichloroethylene in soil and ground water samples. WCC has installed nested ground water monitoring wells and source identification borings to investigate the extent and nature of contamination in the Brunswick Shale aquifer underlying the site. Mr. Gaibrois' waste management assignments have included extensive work with state and federal regulatory agencies.

Mr. Gaibrois has served as the Wayne Business Unit's Health and Safety Officer since early 1986. As such he has been responsible for the development of health and safety plans, field audits of on-site activities, and compliance with governmental and WCC internal programs including WCCs medical monitoring program and OSHA. Mr. Gaibrois has received Level B, C, and D training and has completed Red Cross First Aid and CPR Certification. He has extensive experience in confined space entry work including tanks, sewers and water supply tunnels.

In addition to his involvement with hazardous waste projects, Mr. Gaibrois has been responsible for surface exploration programs, engineering analyses and design, writing of specifications and inspection of construction on a variety of civil engineering projects. In the field, he has supervised the inspection of test borings and probes; the installation and monitoring of field instrumentation such as piezometers, monitoring and observation wells, settlement plates, extensometers, slope indicators and plate load tests; pile driving and load tests; caisson installation; rock excavation by blasting; and compacted fill operations.

Since 1979, Mr. Gaibrois has been Project Manager for WCC's activities at the recently completed \$475 million Jacob K. Javits Convention Center in Manhattan, New York. His responsibilities have included supervision of the field investigation program; analysis and design of foundation systems including piles, caissons, spread footings and mat foundations; and construction supervision. In addition to the Convention Center project, Mr. Gaibrois has managed geotechnical studies for the Sea-Land Corporate Headquarters, General Foods Headquarters, Princeton Forrestal Center, numerous high-rise office buildings in Manhattan, and AT&T Long Lines facilities in the New York area. He has been responsible for the evaluation and design of foundation systems in landfill areas for structures such as methane recovery, refinery and wastewater treatment facilities and sewer investigations.

During 1984, Mr. Gaibrois was Project Engineer for a subsurface investigation and feasibility study for a nine-mile long eight-foot diameter sewer tunnel proposed for the Tottenville section of Staten Island, New York. As such, he directed the activities of the project surveyors, archeological investigation and community relations program. This project included the drilling of approximately 600 test borings, the installation of about 200 observation and monitoring wells, down-hole logging, geophysical surveys, the logging of test excavations up to 80 ft in depth, and the evaluation of the ecological impacts of construction activities on wetlands located in the project vicinity. Construction technologies evaluated included open cut construction methods, free air tunneling with dewatering, compressed air tunneling and pressurized face tunneling.

Mr. Gaibrois has designed and implemented construction monitoring programs for numerous structures adjacent to construction projects. These structures have included computer facilities (e.g. New York Clearing House and New York Commodities Exchange) and microwave facilities (Bell Laboratories). He has also provided these services for landmark status buildings as designated by the New York Landmarks Preservation Commission including Fraunces Tavern, Metropolitan Museum of Art, South Street Seaport Historic District and the Arts Student League Building. These programs have generally included pre-land post-construction inspection of structures, tell tale monitoring of crack widths, ground water level monitoring, vibration monitoring, and determination of acceptable levels for these parameters.

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers

Woodward-Clyde Consultants

ROGER J. HENNING

hydrogeology water quality monitoring monitoring systems design waste management

EDUCATION

Ohio State University: Ph.D., Hydrogeology University of Akron: M.S., Geology Baldwin-Wallace College: B.S., Earth Science

REGISTRATION

Certified Professional Geological Scientist #4800 - AIPG Registered Professional Geologist #511 (Idaho)

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Project Hydrogeologist, 1983-date Morrison-Knudsen Company, Inc., Senior Hydrologist, 1980-1983 Argonne National Laboratory, Asst. Environmental Systems Engineer, 1978-1980 Private Consulting Geologist, Columbus, Ohio, 1976-1978 Field Assistant, U.S.G.S., Waterbury, Connecticut, 1968

REPRESENTATIVE EXPERIENCE

Dr. Henning has extensive experience with hydrogeologic investigations and project management. He has directed waste related investigations which included site characterization, source definition and delineation, plume location, risk assessment, remediation design, and clean-up. Major contaminants were halocarbons (such as TCE), PCBs, coal tars, hydrocarbons (such as benzene), and metals. He has directed projects involving two phase recovery, vapor control, and leak detection and testing.

His experience with water supply includes water quality evaluation, aquifer characterization, and wellfield analysis and modeling. Dr. Henning designed the analytical laboratories, and aided in coordination of operating manuals for water, and sewage systems for the Cerrejon Coal Project in Columbia, South America. He developed a methodology for dewatering and depressuring design for Texas lignite mines which included procurement design.

Dr. Henning has extensive experience in permitting, baseline studies, and property evaluation. This includes hydrological analysis for oil shale and coal mine projects. He was task leader for hydrological analysis and design functions for metals mine treatment plants, and technically supervised analysis of hydrologic controls, water supply development, and environmental control for a proposed underground coal mine and preparation plant.

ROGER J. HENNING

Dr. Henning worked on analysis tasks for the Basalt Waste Isolation Program which includes preparing a drilling and testing plan aimed at determining hydraulic and hydrochemical properties of deep, fractured basalt flows, aquifer test sensitivity analysis, and other technical assistance to Rockwell Hanford Operations. He has also assisted in planning for hydrogeologic investigations for the Office of Crystalline Rock (OCRD), Northeast Project Repository Siting Study.

As co-investigator of the "Environmental Control Technology of the U.S. Strip Mines Project" (a joint DOE-USEPA project), he evaluated field data and compared them to water quality and hydrologic balance requirements on the strip coal mining industry considering to the nation's increased requirements for energy. He also worked on the Argonne Land Reclamation Program, Eastern Province Project hydrology and hydrochemistry tasks. As a consultant to the Office of Surface Mining (OSM) where he developed a plan describing stratigraphy, aquifers, and geohydrologic constraints of surface mining in Ohio.

Dr. Henning has specialized experience in computer modeling of surface water quality and quantity as well as ground water quality and flow. His experience includes use of the major scientific programming languages as well as use of database, statistical, and graphical packages.

PROFESSIONAL AFFILIATIONS

American Geophysical Union
American Water Resources Association
National Water Well Association (Association of Ground Water Scientists and Engineers)
ASTM (Group Leader in D18.01.01 - Ground Water Monitoring Standards)
American Management Association

HONORS AND AWARDS

Spieker Award (Ohio State University)
Listed in "Who's Who in the East"

PUBLICATIONS

Dr. Henning has published over 20 technical papers and participated in numerous technical presentations either as an invited speaker or panelist. Publication list is available upon request.

MARK HOULDAY

hazardous waste investigations ground water contamination studies applied geophysics seismology

EDUCATION

Rutgers University, M.S., Geology, 1983 Montclair State College, B.S., Geosciences, 1978 William Paterson College, B.A., Environmental Studies, 1977

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Assistant Project Geologist, 1987-date Woodward-Clyde Consultants, Senior Staff Geologist, 1983-1986 Woodward-Clyde Consultants, Staff Geologist, 1980-1982 Rutgers University, Teaching Assistant, 1978-1979

REPRESENTATIVE EXPERIENCE

Since joining Woodward-Clyde Consultants, Mr. Houlday has participated in a variety of geologic studies. His experience includes performing hazardous waste and ground water contamination investigations, surface geophysical surveys, and research activities involving contemporary northeastern seismicity. Mr. Houlday has participated in several hazardous waste and ground water contamination studies. His representative responsibilities include: planning the studies, performing the field work, and writing technical reports. Mr. Houlday is currently involved with a large RCRA Facility Investigation (RFI) for a site in New England. Mr. Houlday has participated in all aspects of this investigation including: performing preliminary characterization studies, helping to negotiate the Administrative Consent Order with EPA, and preparing the RFI work plan. As assistant project manager for this investigation, Mr. Houlday is responsible for preparing and monitoring budgets and schedules, and interfacing with the regulators, as required.

Mr. Houlday's experience in performing geophysical investigations includes the application of terrain conductivity to delineate contaminant plume migration and locate buried metallic objects and utilizing electrical resistivity surveys to define subsurface materials and lithologies. He has also participated in several seismic refraction and reflection surveys for a variety of engineering projects. During these investigations, Mr. Houlday is routinely involved with all phases of activities including data acquisition, reduction, interpretation, and technical report preparation.

MARK HOULDAY page 2

Mr. Houlday has extensive experience in research activities pertaining to contemporary seismicity in northeastern United States. He assisted in the design and installation of four microearthquake networks currently operating in selected regions of New York and New Jersey. His representative responsibilities included the collection, analysis and interpretation of network data, compilation of earthquake statistics and catalogs of historical earthquakes for seismic exposure studies and the development of local crustal velocity models. Mr. Houlday also determined source parameters for local and regional earthquakes including fault plane solutions, inferred direction of maximum compressive stress and correlation of epicenters to geologic and tectonic structures for northeastern United States earthquakes.

PROFESSIONAL AFFILIATIONS

Association of Engineering Geologists American Geophysical Union

PUBLICATIONS

"Possible Implications of Recent Microearthquakes in Southeastern New York State", Earthquake Notes, 56, 35-42, 1985, with R.C. Quittmeyer, C.T. Statton, and K.A. Mrotek.

"Recent Seismicity in North- and East-Central New York State", <u>Earthquake</u> Note, 55, 16-20, 1984, with R.C. Quittmeyer, K.A. Mrotek, and C.T. Statton.

"Seismologic Implications of Post 1980 Small Magnitude Earthquakes that Occurred in Regions of New York State Characterized by Low-Levels of Seismicity", M.S. Thesis, Rutgers University, 1983.

Woodward-Clyde Consultants

HAROLD G. LEBLANC

hydrogeology contaminant hydrogeology monitoring systems design ground water supply development

EDUCATION

University of Waterloo: M.Sc., Earth Science (Hydrogeology), 1980 Dalhousie University: B.Sc., Geology, 1975

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Project Hydrogeologist, 1987-date Nolan, Davis & Associates, 1980-1987, Senior Hydrogeologist University of Waterloo, Teaching Assistant, 1977-1979
Nova Scotia Department of Environment, Geologist, 1975-1977

REPRESENTATIVE EXPERIENCE

Mr. LeBlanc currently shares responsibility for project management and business development of hydrogeological activities in the metro New York Office of Woodward-Clyde Consultants. He is also responsible for project management and hydrogeologic assessments on a number of projects. Currently Mr. LeBlanc is Hydrogeologic Task Leader for a TCE cleanup within a fractured bedrock aquifer in Eastern Pennsylvania. He is also responsible for aquifer testing at a second TCE contaminated site in New Jersey within fractured rock. This testing will lead to design of a ground water treatment system. He is presently responsible for an investigation designed to delineate an organic contaminant plume within a surficial aquifer at an operational fiber drum manufacturing facility. Mr. LeBlanc is also responsible for oversite work on two ECRA projects involving a former coal gasification plant and a chemical manufacturing facility. He is presently involved in a Risk Assessment and Feasibility Study at a former coal gas plant site in Central New Jersey.

Recently Mr. LeBlanc has been responsible for several ground water recovery and injection system conceptual designs. Three of these designs were for Superfund Sites and two of these were National Priority Listed sites. He has just completed a major Phase II (Off-Site) Remedial Investigation at a former coal gasification plant site in Central New Jersey. The Phase II work included limited drum excavation work, a soil gas survey, test pit and trench excavation, stream sediment sampling, near surface soil sampling, installation and sampling of monitoring wells. Recently he completed a major aquifer test and analysis within complex surficial materials beneath a former coal gasification plant site. The aquifer is used for water supply. This work will provide the design basis for a ground water recovery system planned for this site which will contain and remediate the existing ground water contamination.

Mr. LeBlanc's project level experience includes landfill siting, assessment, and monitoring system design; site and aquifer contamination assessments; and ground water monitoring network design and installation within sand and gravel, till and fractured bedrock. He has also been involved in site dewatering and contaminant assessment for surface and underground mines, as well as mine related facilities. He has been responsible for several major regional hydrogeological resource assessment projects, water resource exploration/development studies, production well design and installations, and development of sole source aquifer protection plans. Mr. LeBlanc's field experience includes supervision of test borings/water wells, installation of monitoring wells/piezometers, collection of water quality samples for inorganic, trace metal, organic and isotopic analyses; and supervision of aquifer testing programs.

Mr. LeBlanc's contaminant hydrogeology experience includes: geologic and hydrogeologic responsibility for siting and preliminary field assessment of 87, 100-acre disposal sites for controlled wastes; delineation of both inorganic and organic leachate plumes associated with regional landfill sites overlying fractured bedrock and complex surficial materials; participation in a national aquifer contamination assessment program; assessment of the impact of mining related coal pile leachate and acidic drainage on adjacent ground waters; and geologic and hydrologic assessments for expansion of several regional landfill sites.

Mr. LeBlanc's monitoring systems design experience includes: design, installation and sampling of landfill leachate monitoring networks within complex surficial materials and fractured bedrock at several active and abandoned regional landfills; design and sampling of a monitoring network for pesticides; supervision and installation of deep monitoring network components designed to assess seepage at a major proposed hydroelectric site; and design of a monitoring network for a petroleum waste landfill, associated with a major regional refinery.

Mr. LeBlanc's ground water supply development experience includes: hydrogeological assessment of a low-temperature geothermal resource using environmental isotopes; responsibility for three published hydrogeological resource evaluation projects covering a total area of 6,369 square miles; design of production wells capable of producing up to 600 gpm; delineation and development of a 280 gpm production well in a granitic aquifer; delineation of radon gas activities in four major water supply aquifers; design and implementation of ground water exploration and aquifer testing programs; and delineation of hydrogeologic impacts along a proposed 370 mile natural gas pipeline route.

PROFESSIONAL AFFILIATIONS

Association of Ground Water Scientists and Engineers International Association of Hydrogeologists International Water Resources Association International Mine Water Association

Woodward-Clyde Consultants

WILLIAM M. LYON

chemistry
chemical engineering
marine science
hazardous waste
petrochemical process development

EDUCATION

New Jersey Institute of Technology: Completion of Chemical Engineering Course Curriculum, 1985
Long Island University: M.S., Marine Science, 1974
Manhattan College: B.S., Biology/Chemistry, 1968

PROFESSIONAL EXPERIENCE

Woodward-Clyde Consultants, Project Scientist, 1988-date
Havens & Emerson, Inc., Environmental Laboratory Manager, 1985-1988
Chem Systems, Inc., Process Development Chemist, 1975-1985
Graver Water Co., Research Assistant, 1974-1975
Sparling Instrument Co., Inside Salesman, 1973-1974

REPRESENTATIVE EXPERIENCE

Mr. Lyon has four years of experience in environmental chemistry and engineering. Assignments at Woodward-Clyde Consultants have included management of a field investigation project for ground water contamination. Hazardous waste project tasks include site contamination assessments and waste classification determinations. He also has experience in the preparation of site evaluation submittals for New Jersey ECRA (Environmental Cleanup Responsibility Act) projects.

Other areas of expertise include laboratory management; implementation of quality assurance programs and analytical data validations under U.S. EPA protocol; drinking water, wastewater and hazardous waste analysis; field sampling and preparation of data bases. Laboratory management experience includes the operations of a U.S. EPA certified laboratory (Havens & Emerson, Inc.) for water testing in the categories of general chemistry, gas chromatography, atomic absorption, and microbiology.

Regulatory management experience include federal and state permit monitoring programs for industrial discharge (NPDES permits) and water quality for drinking water distribution systems. Mr. Lyon also has some experience in the preparation of mathematical models for the calculations of air emissions.

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WILLIAM M. LYON

Environmental engineering projects have included pilot plant studies for water treatment plants and modifications to existing treatment systems.

Mr. Lyon has a total of ten years of experience in research and process development for the petrochemical industry (Chem Systems, Inc.). Areas of expertise include project supervision from conceptual design through hands on construction and operation of pilot plant units. His experience also includes laboratory research for the licensing of new technology in chemical processes.

Mr. Lyon's M.S. degree involved a specialization in Marine Biology with a thesis on icthyology and ecology of coral reefs. His military experience includes four years with the U.S. Navy as a photographer and oceanographic research technician.

PROFESSIONAL AFFILIATIONS

American Institute of Chemical Engineers

Woodward-Clyde Consultants

CHRISTOPHER MOTTA

superfund investigations surface water and ground water geology sedimentation

EDUCATION

Rutgers University, New Brunswick, New Jersey: M.S., Geology, 1984 Rutgers University, New Brunswick, New Jersey: B.S., Geology, 1980

REGISTRATION

Certified Professional Geologist, AIPG No. 7565

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Assistant Project Geologist, 1988-date Woodward-Clyde Consultants, Senior Staff Geologist, 1986-1988 Woodward-Clyde Consultants, Staff Geologist, 1984-1986 Rutgers University, Research Assistant, 1982-1984 Teledyne Isotopes, Geologist, 1981

REPRESENTATIVE EXPERIENCE

Mr. Motta has project management experience in planning and implementing remedial investigations of USEPA National Priority List sites in New Jersey. Those investigations included several methods of data collection including surface geology evaluation, surface geophysical techniques, drilling, permeability testing, selective-zone sampling and borehole geophysical techniques. Data collection also included field water quality analysis and stream flow measurements.

Mr. Motta has conducted estuarine investigations of the Raritan River and Passaic River Estuaries in New Jersey. The Raritan River Estuary investigation, funded by the NJDEP, was designed to determine the nature of sediment transport and deposition in the estuary. Field work included bathymetric surveys, current velocity and salinity profiling, and bed and suspended sediment sampling. In addition carbon 14 and lead dating techniques were utilized in the study.

The Passaic River Estuary study was designed to determine the extent of dioxin contamination in sediments and to evaluate the potential for transport of sediment out of and within the estuary. Field work was similar to that for the Raritan River Estuary study with the addition of an extensive bed sediment vibratory coring program.

Mr. Motta has experience addressing coal tar contamination at sites in the Coastal Plain of New Jersey. Those investigations included soil, ground water and surface water sampling. In addition, tidal effects on the aquifers were evaluated.

Mr. Motta has experience in evaluating and scoring sites according to the USEPA HRS scoring procedures. Those sites are located in Long Island, New York.

Mr. Motta has completed an instruction and handling training course for radiation safety. Mr. Motta has been fully trained in Level B and Level C health and safety protocol.

Mr. Motta has managed a paint sludge removal action for a National Priority List site in New Jersey. This project involved determining a waste classification according to USEPA protocol, identifying permit requirements, developing plans and specifications for the removal action, and administering the contract. A total of 7,000 cubic yards of material was excavated and hauled from the site.

Mr. Motta is the principal author of two remedial investigation reports and one feasibility study report. Mr. Motta has co-authored other technical reports. Mr. Motta prepared the contract documents associated with the paint sludge removal action.

HONORS

Graduated "With Honors"
Alpha Zeta National Honor Fraternity Candidate

PUBLICATIONS

"The Sedimentology and Hydrology of the Lower and Middle Reaches of the Raritan River Estuary, New Jersey, M. S. Thesis, Rutgers University, 1984.

"Salt Water Instrusion and Fine Grained Sedimentation, the Raritan River Estuary, New Jersey", Geologic Society of America Abstracts with Programs, Northeastern Section, 1983, with G. M. Ashley and W. H. Renwick.

MICHAEL P. NEILSEN

project management environmental assessment risk assessment/management siting economics air quality/meterology

EDUCATION

University of Utah: M.S. Meteorology, 1980 University of Utah: B.S. Meteorology, 1976 University of Utah: B.S. History, 1970

PROFESSIONAL HISTORY

Woodward-Clyde Consultants; Project Scientist, 1987-date TRC Environmental Consultants; Senior Consulting Meteorologist, 1985-1986 American Weather Consultants; Principal Meteorologist, 1983-1985 York Research Consultants; Program Manager, 1980-1983 WAK & Associates; Staff Meteorologist, 1974-1980

REPRESENTATIVE EXPERIENCE

Project Management

Mr. Neilsen has managed complex studies for smelter facilities, electric power generation stations, chemical manufacturing plants, paper and pulp facilities, surface mines, underground mines, commercial developments, and hazardous waste facilities. Significant projects managed include:

- o Program Manager for the preparation of required Environmental Reports in support of Certificates of Environmental Compatibility and Need, for two pipeline projects in the Northeast. One project is located entirely within the State of New York, and must meet the rigorous requirements of the New York State Public Service Commission. The other project covers the states of Ohio, Pennsylvania, and New York, and must meet filing requirements of the Federal Energy Regulatory Commission.
- Project Manager for the preparation of an Environmental Assessment for the crossing of the Niagara River of a natural gas pipeline project, part of a joint venture between Union Gas Ltd., Canada, and ANR Pipeline Company. Simultaneous regulatory authority was claimed by the U.S. Department of State, the New York State Public Service Commission, and the Canadian Energy Board. Reports were tailored to meet the requirements of each of the necessary submissions for this project.

MPN 12/88

- O Program Manager for Woodward-Clyde's participation in the Toxic Catastrophe Prevention Act (TCPA) Task Force of an affiliate company owned in part by Woodward-Clyde Consultants. Mr Neilsen spearheaded the Risk Assessment portion of the required Risk Management Plan prepared for industrial clients in the State of New Jersey. Some clients were advised on the economic consequences in retaining certain facilities affected by the Act and possible alternatives. Mr. Neilsen helped found the task force by providing technical research into the targeted Chemical Process Industry, setting the management direction.
- o Program manager for the SARA Title III services to industrial clients throughout the Northeast, specializing in providing assistance in Emergency Planning, Community Right-to-Know, and Toxic Reporting requirements.
- Project Manager for the environmental permitting of a 156 Megawatt Natural Gas fired Combined Cycle Cogeneration Plant in Pittsfield MA. Mr. Neilsen was responsible for all environmental permitting aspects of this "turnkey" project, including that required for the state's Energy Facilities Siting Council. Mr. Neilsen managed a team of WCC project scientists performing the air and noise analysis, and supervised the activities of a subcontractor on the contract. During the siting analysis, the installation of an above-ground Anhydrous Ammonia tank became a concern to regulatory officials and to the public. Mr. Neilsen supervised a technical review of the hazards of the tank siting, and made recommendations to that were supportive of the clients interests and concerns of the Cogeneration Industry about setting extraordinary regulatory precedent.
- o Presented an Emergency Response seminar to individual chemical manufacturing company in New Jersey. The company had plant representatives from their facilities in New Jersey, New York, Louisiana, Texas, and California in attendance.
- Project Manager of evaluation team to assess the toxic and odor impacts of an industrial accident. Mr. Neilsen was asked to provide emergency onsite meteorological and odor assessment assistance during the accidental release. Subsequently, he headed up a multidisciplinary study team to assess the impacts of the incident for outside counsel retained by the client. Mr. Neilsen designed an innovative odor and toxic assessment methodology using innovative dispersion modeling techniques.
- o Task Manager of a large third party contractor evaluation effort, in conjunction with an EPA Region VIII asbestos abatement enforcement program. Mr. Neilsen provided the USEPA with trained inspectors which made independent reviews of asbestos containment/removal decisions from the USEPA. Additionally, the project responsibilities required air

- sampling outside of the containment area, and observing removal contractor disposal techniques.
- o Program Manager of an extensive periodic and emergency maintenance meteorological tower program for the Yankee Nuclear and Long Island Lighting nuclear power plants in the New England and Long Island areas.
- o Program Manager of a field assessment program for the USDOE, in response to an environmental compliance order from the states of Texas and Louisiana. The network had to cover sites spread over 550 miles, and Mr. Neilsen designed the network and solved the logistics problems involved in the installation in just 60 days from contract award. Mr. Neilsen designed the data reporting system such that exceptionally high data capture was enjoyed by the program.
- Program Manager of an extensive environmental assessment program for a large U.S. Navy complex in Southern California, which included jet engine test cell sites, a large aircraft rework facility, and a disposal site for unexpended "Napalm" aircraft ordinance. The main products of the study included an extensive air dispersion evaluation of the engine test cell sites as part of a mandatory EIR to receive operating permits in non-attainment areas, EIR of the impacts of the aircraft rework facility on the environment, including preparation of spill contingency plans, and evaluation of the air impacts of leaking Napalm canisters at the ordinance depot.
- o Project Manager of an extensive combined field and airborne study to validate complex terrain models. Mr. Neilsen was responsible for the development of the sampling methods for criteria and non-criteria pollutants, and meteorological parameters, on the ground and in the instrumented aircraft. Mr. Neilsen designed the innovative airborne navigation techniques crucial to fixing pollutant concentrations in time and space in the target plume. Additionally, he designed data probing techniques that defined multiple structures of the inversion existing over the study area.

Energy Industry Experience

Mr. Neilsen has significant consulting experience in the energy industry, which includes siting studies, permitting, and field impact assessment programs. He has consulted to fossil fueled and nuclear power plants, as well as cogeneration plants using natural gas and alternative fuels.

o Field monitoring studies for power generation plants in Colorado, Arizona, Oklahoma, New York, Pennsylvania, Connecticut, Maine, Massachusetts, and Vermont.

- o Site selection studies for facilities in the states of Colorado, Oklahoma, Pennsylvania, and Virginia.
- o Environmental assessments for cogeneration facilities in Massachusetts, Vermont, New York, and Pennsylvania.
- o Statistical data evaluation for legal counsel representing a Colorado utility in a non-performance suit against an air control technology vendor.

Chemical Manufacturing Industry

- o Multidisciplinary study to evaluate impacts from accidental release of odorous and toxics compounds into the air from a New Jersey facility.
- o Field assessment study to evaluate the impacts of manufacturing operations on the local environment by a Virginia chemical manufacturer.
- o Retained by a Georgia manufacturer to assess the damage caused by a neighboring company's air emissions.
- o Retained by the USDOE, to assess the material damage and health endangerment from a nearby chemical manufacturer's plume impacting on one of their facilities in the state of Louisiana.

Paper and Pulp Industry

- o Field assessment study in support of a Maine company to meet compliance requirements.
- o Field assessment study to evaluate the odor impact from a New York facility, in defense of a law suit filed by Vermont residents.

Additional Consulting Assignments

Mr. Neilsen was the Principal Meteorologist responsible for the daily weather and wind forecasting support services to the 12 meter racing yachts in the America's Cup racing competition off of Newport RI in 1983. Mr. Neilsen's responsibilities included the design of the systems to gather large scale and local meteorological data. He perfected the methodology to prepare detailed mesoscale forecasts of wind and weather conditions for every hour of the race. Mr. Neilsen selected and trained staff meteorologists to ensure the racing crews were briefed each morning, and that severe weather advisories could be passed to the Race Committee boat if required.

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MICHAEL P. NEILSEN

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association American Meteorological Association

PUBLICATIONS

"Comparative performance of the SHORTZ, LONGZ, and ISC models in an impact study", presented at 1983 APCA National Conference in Atlanta, GA.

"Using the Richardson number as an indicator of stability", presented at the 1983 APCA National Conference in Atlanta, GA.

"Heavy metal deposition study in the Salt Lake Valley", coauthored with W. Klinger, presented at the 1979 APCA National Conference in Houston, TX.

JAMES F. ROETZER

environmental chemistry waste treatment hazardous waste

EDUCATION

Ph.D., Rensselaer Polytechnic Institute, 1978, Environmental Engineering M.S., Rensselaer Polytechnic Institute, 1973, Environmental Engineering B.S. (cum laude), Rensselaer Polytechnic Institute, 1971, Chemistry

PROFESSIONAL HISTORY

Woodword-Clyde Consultants, Senior Project Scientist, 1983-date Envirosphere Company, Division of Ebasco Services, Inc., Principal Environmental Chemist, 1978-1983

REPRESENTATIVE EXPERIENCE

Dr. Roetzer has performed numerous investigations of the fate and effects of chemicals in various environmental settings, including air, water, soil and solid waste. He has performed studies and managed projects for utility, industrial and government clients.

Dr. Roetzer's recent project experience has been primarily in the area of hazardous waste. He is currently managing a major project covering all environmental aspects of decommissioning of a major manufacturing facility. He has been responsible for an investigation of the feasibility of various advanced alternative remedial actions for treatment of hazardous waste sites. He has also developed remedial investigation plans and conducted evaluations of impacts of contamination of soil and ground water at past coal gasification sites. He is currently supervising remedial investigations at a former gasification plant site including innovative application of UV-fluorescence methods to tracking of tars. He has designed and implemented an air monitoring program at a site contaminated with coal tar and other hazardous materials. He has been a principal investigator in a study of the potential usage of a stabilized waste material (fly ash) as a landfill liner material. Dr. Roetzer is currently managing a remedial investigation and evaluation of alternative action at a site in EPA Region II contaminated with widespread low-concentration PCBs from waste oil application. On this project, he has successfully modified field analytical procedures for PCBs to improve accuracy and reproducibility of the test method, resulting in a cost-effective evaluation of contamination over a 50-acre site. He is currently coordinating research activities for in situ PCB degradation at this site.

JAMES F. ROETZER

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Dr. Roetzer has been responsible for compliance activities under the Environmental Cleanup Responsibility Act (ECRA) program in New Jersey. He has served as project manager on several past and current ECRA-related projects, and has prepared ECRA applications and conducted sampling programs at manufacturing facilities, chemical plants, and oil terminals. He has developed investigation programs to meet NJDEP requirements, and has negotiated cleanup plans with NJDEP. He has also conducted site surveys to evaluate potential liabilities for property buyers.

Dr. Roetzer has participated in Endangerment Assessments of several Superfund or other former waste disposal sites. These assessments use risk assessment methods to evaluate environmental and health risks/benefits associated with various alternative remedial actions. Dr. Roetzer was responsible for preparation of an endangerment assessment for a former hazardous material landfill including evaluation of ground water comaminant migration and organic phase migration in a fractured bedrock system. Potential airborne exposure routes were evaluated through modeling of vapor phase transport through the landfill cap, and subsequent atmospheric dispersion.

Dr. Roetzer has analyzed the potential impacts of both organic and inorganic toxic chemicals. He has evaluated the chemical behavior and effects of heavy metals in discharges and aquatic systems. He has evaluated the reactions of airborne uranium hexafluoride, and incorporated these reactions into an atmospheric dispersion model. He has also been responsible for development of models for the mobility, release, degradation, and toxicity of chemicals In landfill settings.

Dr. Roetzer has been responsible for evaluations of water quality and human health impacts for Environmental Impact Statements for power plants, coal gasification plants, and other industrial facilities. He is experienced in the determination of hazardous wastes and waste treatment facility design under RCRA, and hazardous waste site investigations and remediation under CERCLA (Superfund). He has managed RCRA Part B application assistance for a petroleum refinery and a secondary lead smelter. He has participated in several NPDES and SPDES compliance activities, including development of engineering reports for liquid waste treatment systems. He has delivered expert testimony at NPDES hearings.

PROFESSIONAL AFFILIATIONS

American Chemical Society Society of Sigma Xi

PUBLICATIONS/PRESENTATIONS

- Roetzer, J. F., et al. "Treatment by Subsurface Disposal", in Environmental Pollution Control Engineering. Wang, L.K. and N.C. Pereira (Eds). Humana Press, Clifton, New Jersey, in press.
- Roetzer, J. F. 1978. A Kinetic Model for Sediment Phosphorous Release. Ph.D. Thesis. Rensselaer Polytechnic Institute, Troy, New York.
- Roetzer, J. F. 1973. Chemical Quality of Saratoga Lake. M.S. Thesis. Rensselaer polytechnic Institute, Troy, New York.
- Roetzer, J. F. 1985. ECRA Case Studies Presented at ECRA Update: Lessons Learned, May 2, 1985.
- Roetzer, J. F. (coauthor) 1979. Survey of Chemical and Radiological Indexes Evaluating Toxicity. National Low-Level Radioactive Waste Management Program Report No. DOE/LLW-177, March 1983.

DENNIS I. RUBIN

EDUCATION

Colorado School of Mines, Geological Engineer, 1966
University of Michigan, Graduate School of Business Administration, Management
Training Program, 1975

REGISTRATION

Professional Geologist: Idaho (1972); Maine (1974); Virginia (1984); South Carolina (1987-Engineering Geology)

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Manager Electric Energy Services, 1985-date American Electric Power Service Corporation; Division Manager - Civil Engineering Division, 1983-1985; Section Manager - Soils, Foundations, & Hydro Section, 1972-1983; Engineer - Civil Engineering Division, 1970-1972 Stone and Webster Engineering Corporation; Senior Field Engineer, 1966-1970

REPRESENTATIVE EXPERIENCE

Mr. Rubin's most recent assignment was related to the construction of a 280 Ft high, 50,000 acre-foot reservoir complex. In the capacity as Senior Resident Engineer his responsibilities were to supervise construction inspection activities for the earth works and associated structures. He supervised an inspection staff of over 50 personnel for the performance of this work.

As Division Manager, Mr. Rubin was responsible to the Vice President, Engineering Administration for the preparation and execution of plans and design criteria for the Civil/Structural work associated with conventional power generating plants, and nuclear and hydroelectric facilities in the American Electric Power System.

He supervised a staff of sixty people in four sections: Structural Engineering, Soils, Foundations & Hydro, Survey & Mapping, and the Civil Engineering Laboratory. The interdisciplinary staff consists of four Sections Managers, Structural and Geotechnical Engineers, Geologists, Hydrologists, and Mechanical Engineers.

Mr. Rubin was responsible for a budget of approximately \$60,000,000 per year for the engineering studies, planning, design, and construction contracts for site development, and the structural and miscellaneous concrete and structural steel

DENNIS I. RUBIN page 2

for the construction of new fossil, hydroelectric, and nuclear generating facilities. The work is located in the seven-state service area of the American Electric Power System.

As Section Manager at American Electric Power Service Corporation, Mr. Rubin was responsible for the administration and technical supervision for a staff of fourteen people responsible for major power plant projects in the fields of geotechnical design, permitting and contracting, and the licensing and maintenance of hydroelectric facilities.

In the capacity as Section Manager, he supervised the design and construction of four major earth-rock fill dams and the re-analysis of the stability of a concrete gravity dam. During this period, the foundation design and earthwork associated with five 1,300 MW coal-fired generating units was completed and the units placed into commercial operation.

In addition to the construction of new generating facilities, seven precipitator retrofits were engineered and constructed. The above work included the preparation of complete bid documents including supervision of drawing preparation and technical specifications, and the evaluation and recommendation for contract awards.

As an Engineer, he performed site investigations, prepared foundation and earthwork recommendations; and had direct project responsibilities for seven 765 KV stations, two 1,300 MV coal-fired units, and geotechnical review for a major pump-storage project.

At Stone & Weber, Mr. Rubin was responsible for underground technical instrumentation, design and execution of upper reservoir grouting and earth dam fill placement for the Northfield Mountain Pump Storage Project.

PROFESSIONAL AFFILIATIONS

Geological Society of America Association of Engineering Geologists

PUBLICATIONS

Rubin, D.I. and P.J. Mayrose, "Curtain Grouting at Northfield Mountain", Geological Society of America, Vol. 83, No. 7, July 1971, Abstracts, 1972.

Murphy, V.J. and D.1. Rubin, "Seismic Investigations of Landslides", Proceedings of 2nd International Congress of Engineering Geology, 1974.

Woodward-Clyde Consultants

DENNIS I. RUBIN page 3

Stelle, Rubin, Buhac, "Stability of a Concrete Dam - A Case History" ASCE Journal of Power Engineering, 1983.

Stelle, Rubin, Buhac, Anderson, "A New Approach to the Stability Evaluation of a Gravity Dam - The Role of Drainage System and Uplift Pressure", ASCE Journal of Power Engineering, 1983.

W. LEIGH SHORT

chemical process engineering hazardous waste services feasibility studies and site remediation project management

EDUCATION

University of Michigan: Ph.D., Chemical Engineering, 1962 University of Alberta: M.Sc., Chemical Engineering, 1957 University of Alberta: B.Sc., Chemical Engineering, 1956

PROFESSIONAL HISTORY

Woodward-Clyde Consultants; Vice President, Hazardous Waste Services, 1987-date

Radian Corporation; Senior Program Manager, Section Head, 1985-1987 Environmental Research and Technology; Vice President, 1979-1985 University of Massachusetts, Amherst; Professor Chemical Engineering, Department Head, 1967-1979

Chevron Research Company; Senior Process Engineer, 1962-1967 Canadian Industries Limited; Project Engineer, 1957-1959 Atomic Energy Canada; Summer Intern, 1955 Esso Refinery, Calgary; Laboratory Technician, Summer 1954

REPRESENTATIVE EXPERIENCE

Dr. Short is responsible for the management and business development activities associated with WCC hazardous waste services in the Wayne, NJ office. Since joining WCC, Dr. Short has been project manager for the following projects:

- o Preparation of a feasibility study for a superfund site in northwestern New Jersey (commercial client). The FS has been accepted by EPA and NJDEP and a record of decision issued. The site contained paint sludges and was an abandoned mine operation.
- o Preparation of an RI/FS for conversion of a PCB contaminated building and associated property to a residential area. The clean-up standards and techniques are under negotiation with NJDEP.
- o Feasibility study of possible water treatment techniques to allow a waste to energy conversion plant to meet its discharge permits.
- o RI/FS and remediation study for a commercial site with contaminated soil (hydrocarbon) and ground water (TCE), and negotiations with NJDEP.

W. LEIGH SHORT

- o Review for a confidential client of clean up options of a property containing soil contamination (metals and hydrocarbons) and ground water (phenols, base neutral compounds).
- o Project to review cleanup options to remove PCBs from contaminated sediments. The project included a review for the client of various negotiating strategies to determine standards and remedial techniques.

Additionally, he has been responsible for peer review of a significant number of ECRA submissions to NJDEP and treatability programs proposed by other WCC offices.

Prior to joining WCC, Dr. Short was responsible for the management of the Radian East Coast hazardous waste activities. In addition to functions such as strategic planning and budget control, he was project manager for the closure of a lagoon at a site in North Carolina and the remediation of a site in Connecticut, as a part of a property transfer. He acted as project manager for investigations of possible air pollution problems arising from a gasoline spill and for the preparation of legal/expert testimony to assist in permitting a steel plant modification.

While at Environmental Research and Technology, he was responsible for a group of 120 engineers, chemists, geologists, and soil scientists. He was project manager for the design, procurement, installation, and startup of a liquid hazardous waste treatment facility. This project included extensive treatability studies. He was also project manager to prepare the bid specifications and procure the necessary contractors for the dismantling of a refinery, and project manager of an environmental impact/permitting study for the modification of a large Gulf Coast refinery.

While at the University of Massachusetts, in addition to his research activities in air and water pollution control, he was co-owner of a small consulting firm, KSE Inc. In this capacity, he was active in projects to determine the cost to the petroleum industry of removing sulfur from gasoline and diesel fuel, the impact on the California petroleum industry of processing Alaskan crude oil, and to evaluate various technologies capable of meeting BAT regulations in the plastics and petrochemical industries.

During his employment at Chevron Research, he worked in the development, design, construction, and startup of a novel waste water treatment process for Chevron. This resulted in several patents and the process is licensed by Chevron world wide. He also was responsible for the preparation of the process section of the bid specification of a solvent deasphalting plant, and served as the Chevron process representative in the offices of M.W. Kellog during the design of this facility. After construction, he prepared operator training manuals and served on the startup team.

Woodward-Clyde Consultants page 3

W. LEIGH SHORT

At Canadian Industries, he served as a project engineer managing plant construction projects, and was responsible for the design of high-pressure heat exchange equipment.

REGISTRATION

Professional Engineer: Texas 1984

PROFESSIONAL AFFILIATIONS

Air Pollution Control Association
American Association for the Advancement of Science
American Chemical Society
American Institute of Chemical Engineers
Environmental Protection Agency
Science Advisory Board, Member 1974-1980
Grants Peer Review Committee
Review Panel for Small Business Innovative Research Programs

ALBERT H. WOEHRLE, JR.

transportation civil engineering technical administration

EDUCATION

Cornell University, Ithaca, New York: M.S., Transportation Engineering, 1957 Drexel University, Philadelphia, Pennsylvania: B.S., Civil Engineering, 1956

REGISTRATION

Professional Engineer: New Jersey, New York and Pennsylvania

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Administrator, 1988-Present Howard F. Greenspan Associates, Director of Operations, 1985-1988 Exxon International Company, Senior Marine Planner, 1968-1985 Tri-State Regional Planning Commission, Manager of Highway Planning, 1963-1968

Delaware Valley Regional Planning Commission, Transportation Engineer, 1960-1963

Urban Engineers, Inc., Transportation Designer, 1958-1959

REPRESENTATIVE EXPERIENCE

Since joining Woodward-Clyde Consultants, Mr. Woehrle has been responsible for preparing budgets and financial forecasts and monitoring performance versus plan for the firm's 100 person New York Metropolitan offices.

Mr. Woehrle had similar responsibilities at Howard F. Greenspan Associates where he also was in charge of invoicing and accounts receivable collections.

During his employment by Exxon International Company, Mr. Woehrle administered a worldwide system designed to reward quick turnaround of ships at loading and discharge ports. He also developed a reporting system which identified crudes, terminals and vessels which had consistent volume measurement problems. The follow-on remedial measures resulted in annual savings of \$30 million.

As Highway Planning Manager of the Tri-State Regional Planning Commission (New York metropolitan area), Mr. Woehrle was responsible for collecting data to describe the regional highway network as well as coding and testing existing and proposed networks using computer models. Organizational studies and annual budgets were also prepared and justified.